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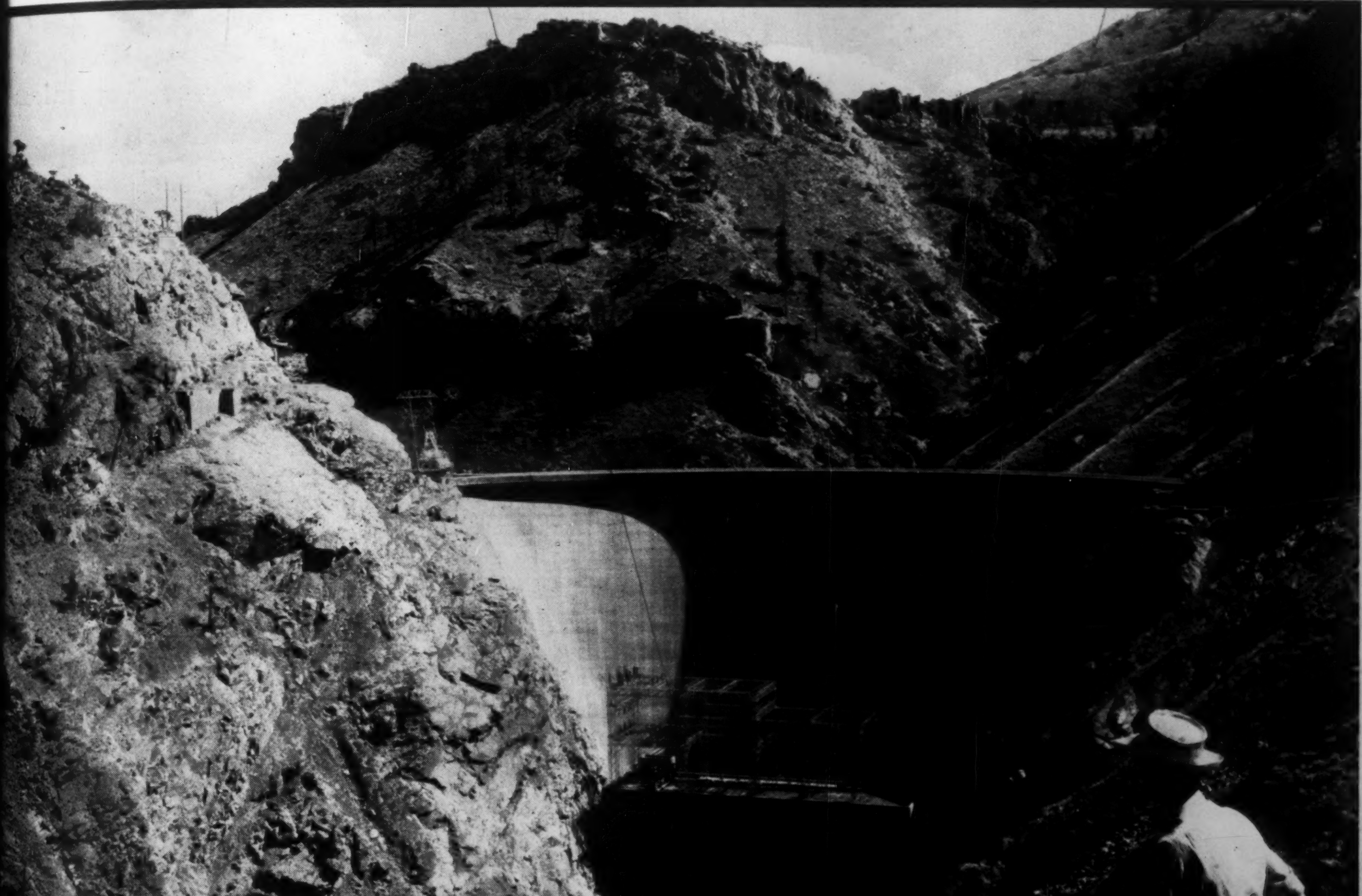

Seminoe Dam on the Kendrick Reclamation Project (See Article, Page 461)

Volume 14 Number 11
NOVEMBER 1944

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Harry W. Bashore (Lagrange College, A.B. '99; U. of Mo., B.S. in C.E. '06) has had 38 years of continuous engineering experience, mostly with the Bureau of Reclamation—on the North Platte, Vale (Ore.), Grand Coulee, Central Valley, and Kendrick projects. In 1939 he became Ass't. Commissioner of Reclamation, and in 1943 Commissioner.

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This Issue Contains

NORFORK DAM IN ARKANSAS NEARS COMPLETION. I. Design for Both Flood Control and Power Generation 455
G. R. Schneider

SAFEGUARDING CREDIT IN CONSTRUCTION 459
James J. Lucy

REGIONAL DEVELOPMENT OF THE MISSOURI BASIN 461
Harry W. Bashore

A PLAN FOR THE REGIONAL DEVELOPMENT OF TOMORROW 465
Harry S. Truman

PUBLIC WORKS PLANNING AS AID TO GENERAL POSTWAR EMPLOYMENT 466
Everett M. Dirksen

ENGINEERING ASPECTS OF MOSQUITO CONTROL. II. Malaria Control in War Areas 467
Mark D. Hollis

FACTS AND FIGURES ON CONSTRUCTION TRENDS. II. Economic Problems and Challenge for the Future 471
Elsie Eaves

ENGINEERS' NOTEBOOK

- Velocity-Head Rod Calibrated for Measuring Stream Flow . . . 475
  H. G. Wilm and *H. C. Storey*
- The Two Moment-Area Theorems—A New and Shorter Method of Proof 476
  Donald Bregman

OUR READERS SAY 477

SOCIETY AFFAIRS 479

STUDENT CHAPTER ANNUAL REPORTS 487

ITEMS OF INTEREST 491

NEWS OF ENGINEERS 14

DECEASED 14

CHANGES IN MEMBERSHIP GRADES 16

APPLICATIONS FOR ADMISSION AND TRANSFER 20

ENGINEERING SOCIETIES' PERSONNEL SERVICE 26

CURRENT PERIODICAL LITERATURE 28, 30, 32, 34, 36, 38

EQUIPMENT, MATERIALS, AND METHODS 40, 43, 44, 46

INDEX TO ADVERTISERS 50

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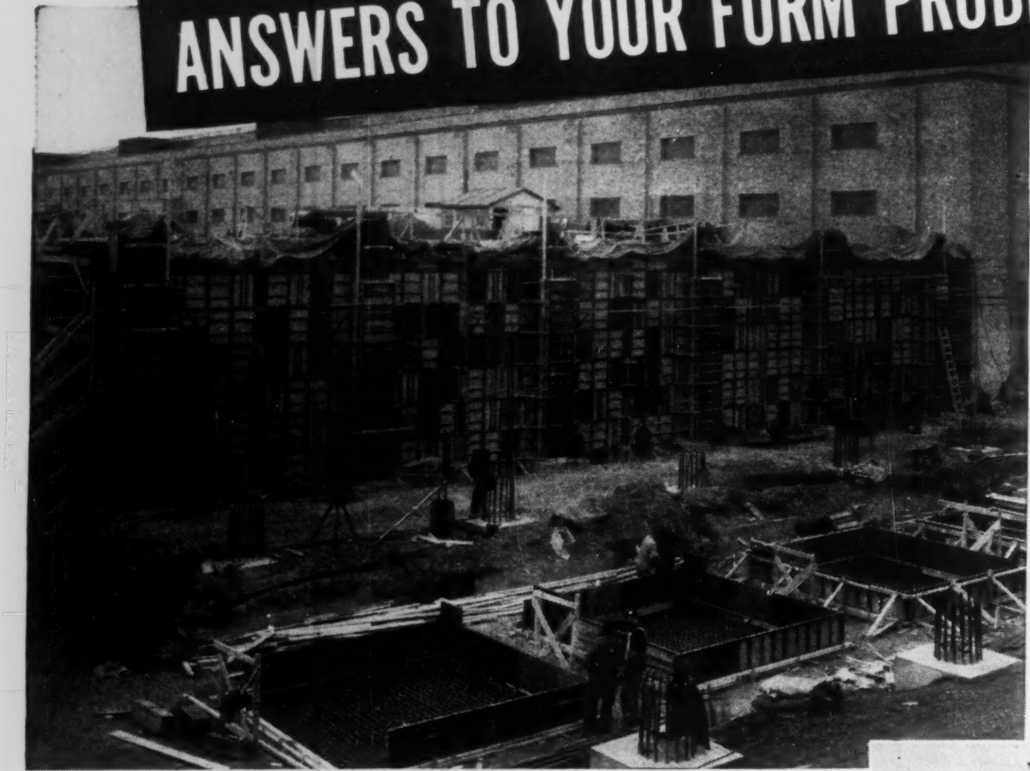

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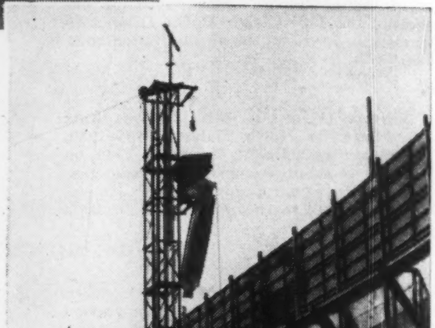

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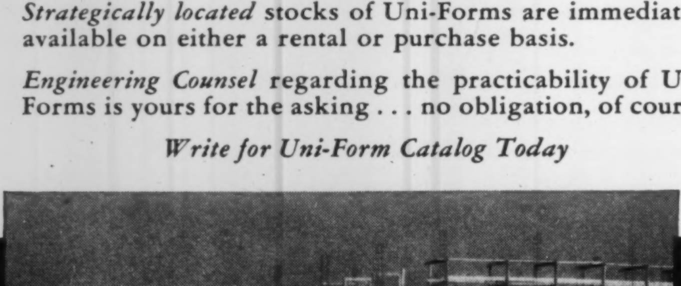

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VOLUME 14 NOVEMBER 1944 NUMBER 11

Norfork Dam in Arkansas Nears Completion

I. Design for Both Flood Control and Power Generation

By G. R. SCHNEIDER, ASSOC. M. AM. SOC. C.E.

LIEUTENANT COLONEL, CORPS OF ENGINEERS; CHIEF, ENGINEERING DIVISION, U.S. ENGINEER OFFICE, LITTLE ROCK, ARK.

NORFORK Dam is near the town of Norfork, Ark., about 100 air-line miles from the city of Little Rock. It was constructed across the North Fork River about 5 miles from its confluence with the White River. The North Fork River contributes a substantial flow to the White River which, rising in northwestern Arkansas, flows northeastward and then southeastward to the Mississippi and drains an area of about 28,000 sq miles in Missouri and Arkansas. The lake formed by the dam will be about 43 miles long and will extend some 10 miles into southern Missouri—to the vicinity of Tecumseh, about 180 miles southwest of St. Louis. The project is one unit of a comprehensive plan for flood control of the White River and tributaries. It will also provide a substantial amount of hydroelectric power and is expected to become a scenic and recreational center.

The earliest reports of the U.S. Engineers dealing with reservoirs for flood control on the White and Mississippi rivers considered a dam in this vicinity, and even before these flood-control studies, private interests had investigated the location and considered it suitable for construction of a dam for hydroelectric power. Construction of the dam as a flood-control structure, with provisions for future power installations, was authorized by Congress in the Flood Control Act approved June 28, 1938. Funds were made available for planning and detailed investigations in June 1939, and for design and construction in June 1940. Construction of preliminary works, including an access highway, a construction railroad, and a housing project, was initiated in the fall of 1940. A contract for construction of the dam was awarded jointly to the Utah Construction Company and to the Morrison-Knudsen Company, Inc., of Ogden, Utah, and Boise, Idaho, respectively, in March 1941, and construction of the structure was under way within a month.

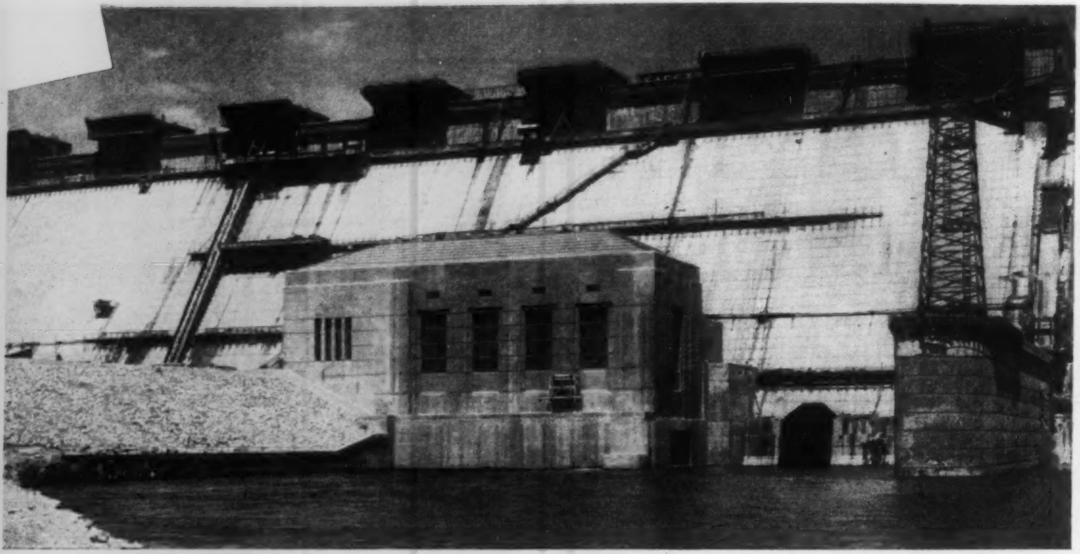
Pertinent Data on Norfolk Dam and Reservoir

Drainage area above dam, sq miles	*1,806*
Average annual stream flow, cu ft per sec	*1,790*
Maximum flood of record, cu ft per sec	*120,000*
Height of dam above foundation, maximum, ft	*244*
Crest length, ft	*2,624*
Total concrete, cu yd	*1,500,000*
Total reinforcing steel, tons	*1,800*
Gross length of spillway, ft	*568*
Number of radial crest gates	*12*
Maximum spillway discharge, cu ft per sec	*331,000*
Number of discharge conduits	*11*
Total capacity of discharge conduits, cu ft per sec	*21,000*
Number of penstocks	*4*
Total storage capacity, acre-ft.	*1,983,000*
Storage for flood control, acre-ft	*732,000*
Gross head, power pool full, ft	*174*
Area of reservoir, flood pool, acres	*30,700*
Number of turbines to be installed	*4*
Capacity of each at best gate, hp	*42,000*
Prime capacity of each unit, kw	*27,000*
Total annual energy output, average, kwhr	*145,000,000*

In the Flood Control Act approved August 18, 1941, Congress approved a modification of the project to include the development of hydroelectric power. An analysis of the power requirements of the area indicated that the power would be needed for national defense and in August 1942 a "speed-up" program for construction of the dam was initiated so that storage of water for power generation could be started sooner than would have been possible under the original plan of construction. The Harza Engineering Company of Chicago, Ill., prepared plans and specifications for the power plant and, in September 1942, a contract for its construction was awarded to the contractors for the dam.

Separate contracts were awarded for furnishing the turbine, generator, and other items of equipment. The power plant was placed in operation in June 1944. The power is being sold by the Southwestern Power Administration, an agency under the jurisdiction of the Secretary of the Interior, who was authorized to market the power by an Executive Order of the President in July 1943. The dam will be completed late in 1944, except for spillway gates and some other work which requires critical materials and is not essential to wartime operation of the project. Temporary provisions have been made by construction of concrete bulkheads on top of the spillway crest to obtain flood control until the supply of material needed for spillway gates and operating machinery is less critical.

The Norfork Reservoir is one unit of a general comprehensive plan for the control of floods on the White and Mississippi rivers and for the development of the water resources of the White River Basin in Missouri and Arkansas. The primary purpose of the project is flood control. The drainage area upstream from the dam, 1,806 sq miles, is about 16% of the drainage area of the White River above Batesville, Ark., and about 6%



PROVISION HAS BEEN MADE FOR FUTURE UNITS NEXT TO SINGLE GENERATOR NOW INSTALLED

of the total drainage area of the White River. Flood flow from the North Fork River has been an important factor contributing to flood damage in the lower White River Valley. The estimated peak discharge of the three largest floods of record on the White River at Batesville varied from 354,000 to 380,000 cu ft per sec. Corresponding peak discharges from the North Fork River for the same floods varied from 90,000 to 120,000 cu ft per sec.

Because the records show that floods may occur at any season of the year, a storage capacity of 732,000 acre-ft has been allocated exclusively for flood control. This capacity would have permitted reduction of the flow at the dam site to a uniform rate not exceeding 5,000 cu ft per sec during all major floods of record.

In addition to flood control, the project will provide for the generation of hydroelectric power. The average flow in the vicinity of the dam site for $19^3/_4$ years of actual and estimated record was 1,790 cu ft per sec. Average weekly flows have varied from 323 to 27,400 cu ft per sec. With the storage capacity of 707,000 acre-ft now allocated for power drawdown, the stream flow could have been regulated to provide an average flow of 1,260 cu ft per sec during the most severe dry period of past record. This flow would permit generation of 12,370 kw of prime continuous power. Total energy available in an average year will be about 145,000,000 kwhr.

Fish and game are plentiful in the region, and the project is in the "Mississippi Flyway," one of the principal routes followed by migratory waterfowl. The project area is not located in the malarial mosquito zone, and health conditions in the vicinity are good. In general, the shore slopes are steep, and there will be few places favorable for mosquito propagation. The project will be easily accessible to a large number of people, many of whom live in urban centers, and it is expected that the lake will be used extensively for fishing, hunting, and other recreation when wartime travel restrictions are lifted. The cities of Tulsa, Kansas City, St. Louis, Memphis, and Little Rock are all within a radius of 230 miles of the project.

The region in which the project is located is the oldest land surface between the Appalachians and the Rocky Mountains and is composed of ancient sediments of limestone with some shale and sandstone that were uplifted and submerged several times before the final uplift. The rock strata are relatively flat with some local folding and faults. The soil above the flood plain is a residuary product of weathering and is relatively thin on the hills. The rivers, which flow on bedrock in narrow flood plains, have cut deep valleys with meandering courses, resulting in relatively narrow upland ridges. The alluvial material in the flood plains is composed principally of silt and sand and seldom exceeds 30 ft in thickness. On the outside of river bends there are usually steep cliffs with hard, sound rock a few feet beneath the surface; on the inside there are usually gentle "slip-off" slopes covered with residual overburden.

FOUNDATION CONDITIONS AT THE SITE

The dam site is at the end of a long, sweeping bend to the right, and the left abutment is the typical steep cliff. The right abutment, also typical, has a uniform slope of moderate steepness. Explorations before construction revealed that weathering had formed a blanket of residual overburden composed of clay or clay-like material to a depth of 20 to 45 ft on the "slip-off" slope, and that the underlying rock surface was very irregular, with crevices and clay-filled pockets extending as much as 15 ft below the general rock surface. Overburden on the left abutment was thin and spotty. On the flood plain it consisted chiefly of silt and sand averaging 18 ft in depth. Explorations before construction started included three large trenches and over 23,000 lin ft of core drilling. Core recovery at the selected site averaged 97.4%.

In general, the foundation rock is moderately hard to hard bedded limestone, the beds ranging from less than 1 ft to about 5 ft in thickness, with a few beds of hard, calcareous shale, some shaly limestone, and some chert. The shale varies from thin partings along the limestone bedding planes to one bed 8 ft thick. Only the thicker beds are persistent over wide areas. Tests on samples of the foundation rock showed weights from 156 to 171 lb per cu ft; compressive strengths from 10,000 to 30,000 lb per sq in.; moduli of elasticity from 1,200,000 to 14,700,000 lb per sq in.; and coefficients of sliding fric-

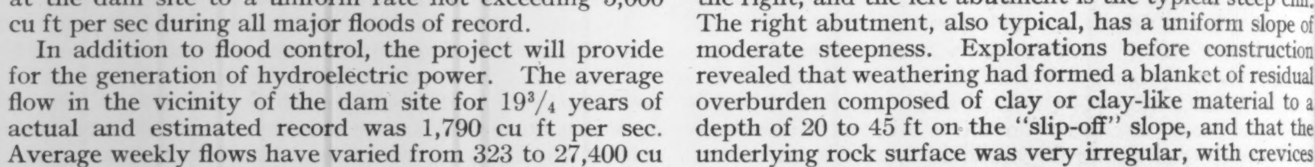


FIG. 1. DOWNSTREAM ELEVATION OF NORFORK DAM

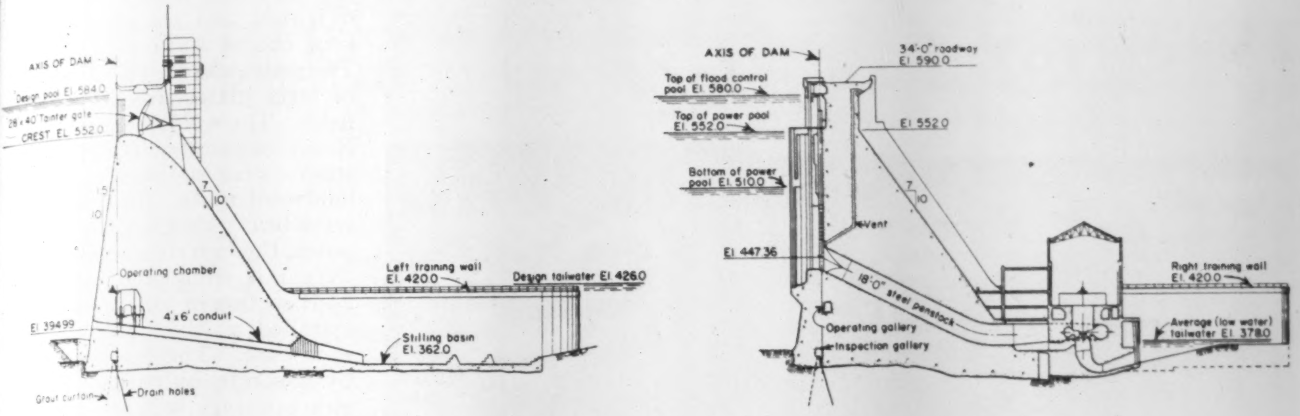

AXIS OF DAM
Design pool El. 584.0
28 x 40 Tainter gate
CREST EL 552.0
1.5
10
7
10
Operating chamber
Left training wall
El. 420.0
Design tailwater El. 426.0
El. 394.99
4'x6' conduit
Stilling basin
El. 362.0
Grout curtain
Drain holes
AXIS OF DAM
34'-0" roadway
El. 590.0
Top of flood control pool El. 580.0
Top of power pool El. 552.0
El. 552.0
Bottom of power pool El. 510.0
7
10
Vent
El. 447.36
18'-0" steel penstock
Operating gallery
Inspection gallery
Right training wall
El. 420.0
Average (low water) tailwater El. 378.0

Fig. 2. Section Through Spillway (Left) and Power House (Right) of Norfork Dam

tion on cement grout from 0.59 to 0.86. The water table in the abutments is high, indicating watertightness. Tightness was insured by a grouting program consisting of holes 3 in. in diameter on 4-ft centers, drilled along the axis of the dam, inclined upstream at an angle of 10 deg from the vertical, to depths varying from 30 to 150 ft beneath the dam. To provide for adequate relief of uplift pressure downstream from the grout curtain, cored holes 5 in. in diameter were drilled, inclined downstream at an angle of 15 deg from the vertical. About 95% of these holes were drilled to a depth of 50 ft below top of rock, and the remainder varied in depth from 50 to 100 ft. These holes were drilled after all grouting within a distance of 150 ft had been completed.

DAM AND SPILLWAY

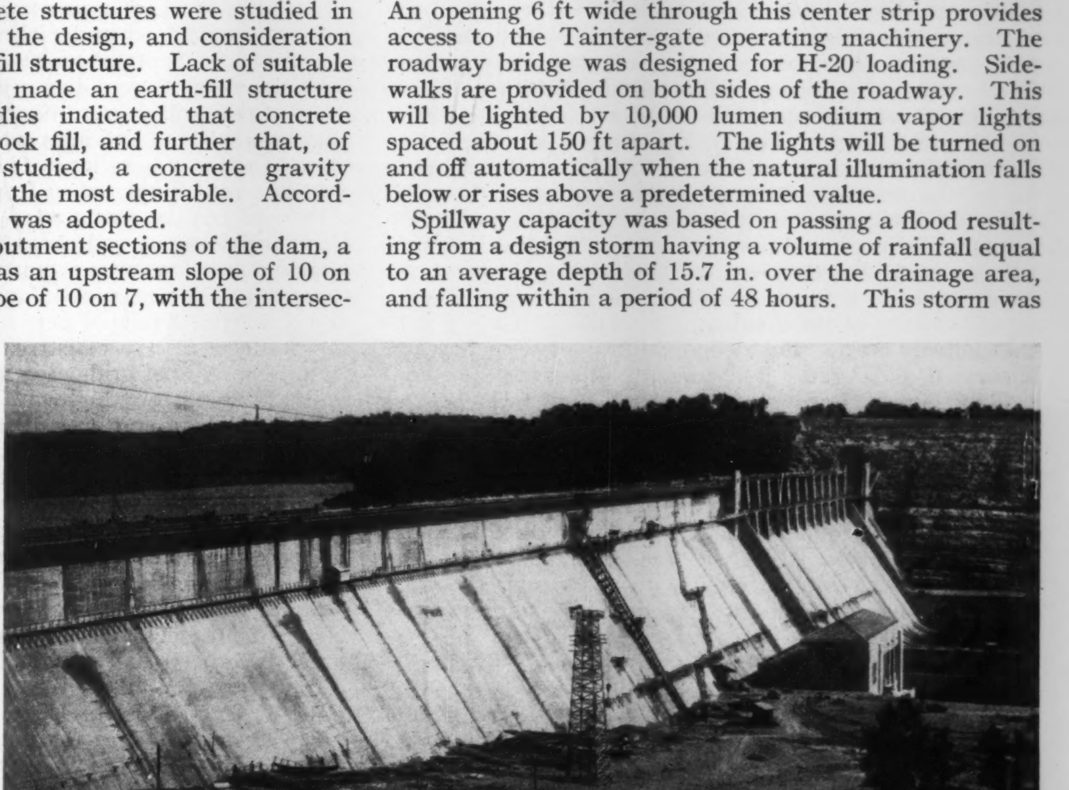
Several types of concrete structures were studied in the preliminary stages of the design, and consideration was also given to a rock-fill structure. Lack of suitable materials in the vicinity made an earth-fill structure impractical. These studies indicated that concrete was more suitable than rock fill, and further that, of the concrete structures studied, a concrete gravity structure appeared to be the most desirable. Accordingly, this type (Fig. 1) was adopted.

For the non-overflow abutment sections of the dam, a section was used which has an upstream slope of 10 on 1.5 and a downstream slope of 10 on 7, with the intersection of the projected slopes occurring at the elevation of the spillway design flood pool. Stability analyses were made based on the assumption of a straight-line variation of stress and on uplift pressure equal to 100% of the headwater pressure at the heel of the dam and decreasing uniformly to 100% of the tailwater pressure at the toe, effective over two-thirds of the base area. These analyses showed the resultant pressure to be inside the middle third of the base, and the ratio of horizontal to vertical forces to be 0.56. Although there have been no indications of serious seismic disturbances in the area in recent times, analyses were made on an earthquake force with an acceleration factor of 0.1 gravity. These analyses indicated that the resultant pressure would be slightly outside the middle third of the base, and that the ratio of horizontal to vertical forces would be 0.75 under such conditions. The spillway section of the dam (Fig. 2) was designed for the same conditions of loading.

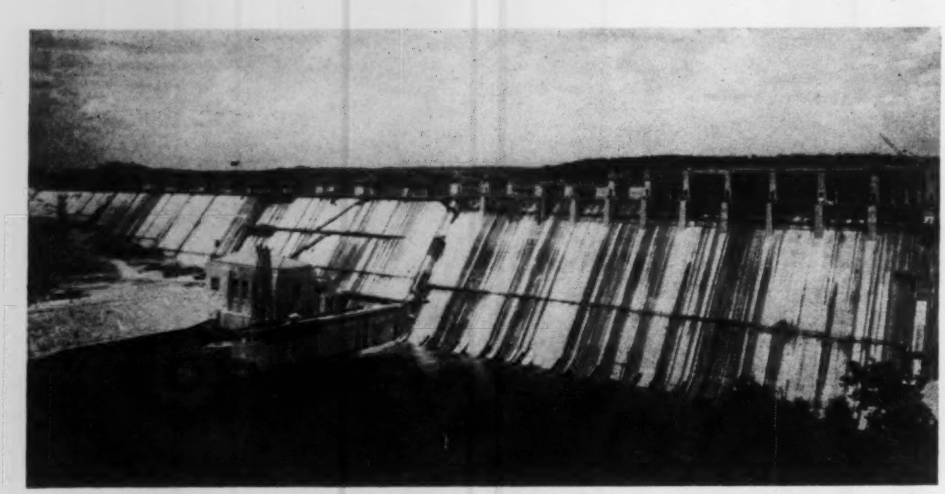
ROADWAY CROSSES DAM

A roadway on top of the dam crosses the spillway on a reinforced concrete bridge consisting of twelve 40-ft clear spans simply supported on piers constructed on the spillway crest. The roadway on the bridge is divided into two 13-ft lanes separated by a center strip 8 ft wide. An opening 6 ft wide through this center strip provides access to the Tainter-gate operating machinery. The roadway bridge was designed for H-20 loading. Sidewalks are provided on both sides of the roadway. This will be lighted by 10,000 lumen sodium vapor lights spaced about 150 ft apart. The lights will be turned on and off automatically when the natural illumination falls below or rises above a predetermined value.

Spillway capacity was based on passing a flood resulting from a design storm having a volume of rainfall equal to an average depth of 15.7 in. over the drainage area, and falling within a period of 48 hours. This storm was



Steep Rock Cliff Forms Left Abutment of Norfork Dam



TAINTER GATES CONTROL FLOOD FLOW OVER SPILLWAY

assumed to follow a large flood, which had substantially filled the flood-control storage. After a study of existing records, an infiltration rate of 0.06 in. per hr was selected as being the minimum rate that could be expected under weather conditions that would produce such a succession of floods, with a resulting average runoff for the storm of 82%.

It was estimated that the natural peak flow of this flood at the dam site would be 346,000 cu ft per sec. The travel time of the flood peak through the reach of river occupied by the reservoir will be much less than under natural conditions, and it was estimated that the flood peak would be increased to 372,000 cu ft per sec if passed directly through the full reservoir. Flood routing studies indicated that such a flood would fill the reservoir to a maximum elevation of 584, and that the peak outflow would be reduced to 331,000 cu ft per sec. Flow over the spillway will be controlled by twelve individually motor-operated Tainter gates, each 40 ft long by 28 ft high. The stilling basin was designed to pass safely the peak outflow on the basis of hydraulic model studies made for similar structures.

The spillway crest is at the same elevation as the top of the power pool, and it is anticipated that flood releases will be made largely over the spillway. However, 11 conduits, each 4 ft wide by 6 ft high, will provide for rapid lowering of the flood pool with the water level near the spillway crest. Each conduit has an emergency and a service slide gate, hydraulically operated, for controlling flows. Because of the head under which these gates will normally operate, particular attention was given to the design of the gate leaf to insure minimum deflection, and to the design of the seals to insure a reasonable distribution of load. The seals are of specially selected bronze, capable of withstanding pressures up to 10,000 lb per sq in. without appreciable seizure or chattering. The seals are $1^1/_2$ in. thick, and the computed seal pressures under conditions of maximum load vary from 2,220 lb per sq in. to zero in a width of 2 in.

POWER PLANT

At the base of the downstream face of the right nonoverflow section, adjacent to the spillway, is the power house (Fig. 2). The penstock intakes were designed to produce gradually converging and accelerating flows with minimum energy loss. The trash racks consist of rectangular panels with bars spaced 6 in. on centers. The penstock headgates, constructed of structural steel with rubber seals, are of the tractor type, counterweighted, and are lifted by roller-type chains and individual hoists. The penstocks are 18 ft in diameter, of steel plates arc-welded in the field. The welds were subjected to X-ray inspection. Complete penstocks were provided for the two landward units. In order to conserve heavy steel plate for war purposes, the two riverward penstocks were not completed, and only a 24-ft section of steel penstock was installed at the upstream end in each case. The inlets were closed by concrete bulkheads, and oversize openings were formed downstream through the dam to permit future erection of the remainder of the steel penstocks.

As constructed, the power house has space for two main generating units. However, because of war conditions, only one was installed—a vertical-shaft, single-runner, Francis-type turbine, and a 3-phase, 60-cycle, 13,800-v generator having a normal rating of 38,889 kva, 0.9 power factor, and a speed of 128.6 rpm. A station-service generating unit with a rated capacity of 500 kva, 0.8 power factor, will supply power for use in the power house and the dam.

RESERVOIR CLEARING AND RELOCATIONS

The reservoir area was cleared to an elevation of 3 ft above the top of the power pool, it being considered that much of the forest growth in the flood-control pool would not be injured by infrequent inundation. The clearing involved a total of approximately 23,100 acres of land and was performed under three separate contracts and completed in September 1943.

There were 26 cemeteries in the reservoir area from which 1,900 graves were removed and relocated at suitable sites selected and approved by the relatives of those buried in the cemeteries. This work was performed by contract and completed in April 1943.

Several county roads were affected by the reservoir. However, some served areas that have been inundated and no relocations were required. In one instance, it was necessary to reconstruct 4.7 miles of existing county road and construct 1 mile of new road. In another instance, it was necessary to construct a half mile of new road, including a timber bridge to replace an existing low-water bridge. One state highway and one federal highway were in the reservoir area about 15 miles upstream from the dam. An agreement was effected with the State Highway Department whereby these roads will be relocated after the war emergency. The State Highway Department is now operating two 6-car ferries across the reservoir to connect the ends of affected routes.

Planning and supervision of the Norfork Project have been done by the Little Rock District, U.S. Engineer Department. The District Engineers responsible for the work have been successively: Lt. Col. (now Brig. Gen.) S. L. Scott; Col. T. F. Kern; Col. A. M. Neilson; and Col. W. A. Davis. Dr. L. C. Glenn was the consulting geologist, and the engineering consultants were W. H. McAlpine, J. P. Growdon, and J. D. Justin, all Members Am. Soc. C.E.

Construction methods used by the Utah Construction Company and the Morrison-Knudsen Company, contractors for dam and power house, will be described in an article to be included in the December issue.

Safeguarding Credit in Construction

By JAMES J. LUCY

CONTRACT BOND UNDERWRITER, GENERAL AGENT FOR MARYLAND CASUALTY COMPANY, NEW YORK, N.Y.

JUSTLY, the engineering profession is proud of the contribution it makes in designing practical and efficient structures and works, and in supervising and assisting in their construction, but engineers do not appreciate, as fully as they should, the importance of employing an experienced, responsible, and capable contractor to carry out these plans. If we are to have uniform prequalification laws and standards for selecting competent bidders for public work, then the engineering profession should see to it that a civil engineer, as well as an architect, is on each such prequalifying body. This can readily be done by a concerted effort to have the owner's engineer chosen as a member of all such public groups. This activity will be more effective if undertaken in cooperation with other responsible organizations within the construction industry, both nationally and locally.

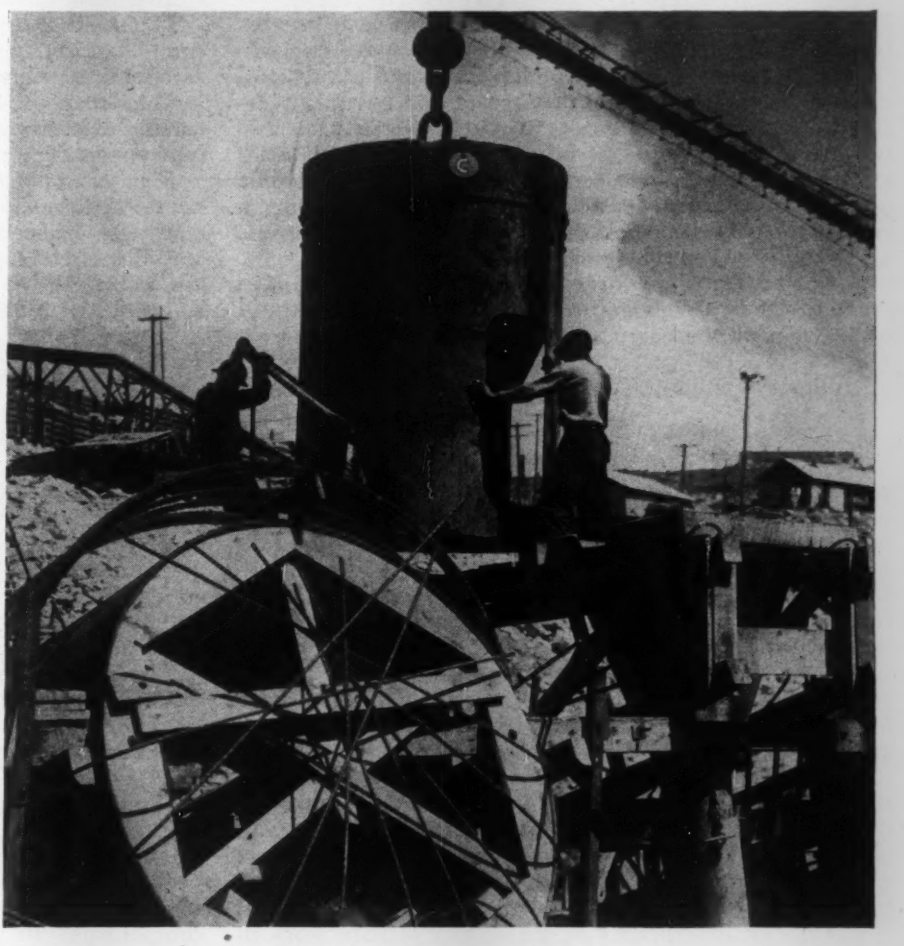
Public owners, architects, general contractors, subcontractors and material men, through various organizations interested in a sound postwar economy for the construction industry, have given much thought to the improvement of credit risks incidental to postwar construction. Plans for uniform prequalification standards for contractors and subcontractors have been supplemented by proposals looking toward the general use of separate performance bonds, and payment bonds protecting labor and material men against credit losses. Such losses invariably lead to increased costs, and consequently limit the volume of work which available appropriations can finance.

Civil engineers have a stake in perfecting such plans, but their interest is not often evidenced by practical cooperation with these affiliated interests serving the construction industry as a whole. For instance, a joint committee of the New York Building Congress and the New York Chapter of the American Institute of Architects has recently drafted revised performance and payment bonds, in cooperation with officials of the bonding companies, which will benefit the engineering profession as well as the architectural profession. Consideration of the subject by this committee gave the architect members an opportunity to understand the technical necessities for an independent guarantee of the future stability of the construction industry, such as corporate suretyship offers through the medium of such bonds. A brief analysis of the need for credit protection and the effect of credit losses in construction may be helpful in enabling engineers to solve this immediate problem.

The construction industry is a highly speculative business transacted substantially on credit. Public works are financed by bond issues, and private construction by mortgage loans. Contractors finance their work on credit extended by subcontractors, material men, equipment suppliers, and bankers. Even these latter trade creditors finance their participation on credit from manufactures and other sources of materials.

In boom times money is "easy" and credit is freely extended. In intervening depressions substantial credit losses are suffered when the volume of transactions which create "easy" money are suddenly contracted and liquidation of indebtedness is correspondingly slowed. Building construction is particularly sensitive to these economic factors, as was proved during the period 1930–1933.

The construction program incidental to National Defense expanded the capacity of the construction industry, with the result that many new contractors entered the public works field, and existing contractors undertook a volume considerably beyond their peacetime performance. Large profits were earned by expanded organizations of competent but expensive personnel. The prosperity enjoyed in the earlier years has been somewhat liquidated by renegotiation of contracts and increased taxes. Continuing overhead costs without sufficient new income will further reduce the net working



IT IS IMPORTANT THAT EXPERIENCED AND RELIABLE CONTRACTORS BE SELECTED TO CARRY OUT THE ENGINEER'S PLANS capital of contractors to a point where the wartime appreciation of capital will generally be consumed in maintaining the competitive organizations which contractors will need to insure an early and satisfactory participation in postwar construction.

While awaiting the end of hostilities, operating contractors, and their subcontractors and material men, will experience a highly speculative type of competition due to the uncertainties of continued wartime economic controls, inflationary influences tending to increase material costs, and scarcity of labor, with lessened productivity of the labor available in the busy war centers where remaining war construction is needed. Contract prices will probably be on a cost-plus-overhead basis, without a proper margin to meet even the normal contingencies of a business as hazardous as construction has always been.

FOUNDATION OF CREDIT

The foundation of credit is integrity. While ability and capital are requisites for successful contracting, character and integrity are the elementary qualifications upon which a good credit standing must be based. Ability is the product of experience and training, but a corporate organization can supplement the ability of its personnel by employing men of the necessary experience or training to fill the needs of particular contracts.

The sufficiency of a contractor's working capital is dependent upon collateral circumstances, such as the volume of work on hand and the type of contract undertaken. A contractor of integrity and ability would require less of a capital margin as a credit risk than would a less experienced or less reliable one. Capital accumulated through successful work over a period of years is not likely to be risked in speculation and is entitled to greater respect as a credit factor than newly invested capital.

Owners and their technical advisers should not depend on the past reputation of contractors, but should investigate the present financial worth of the contractors whom they may invite as bidders. A current financial statement prepared and certified to by a certified public accountant is usually a reliable means of evidencing a contractor's worth. Schedules of the important assets and liabilities should be part of such a statement.

Confirmation of the foregoing qualifications is the ultimate in credit investigation. The fact that losses still occur when all these circumstances are favorable suggests the need of some greater protection to stabilize the building industry. That added factor is the payment bond.

SEPARATE PAYMENT BONDS

Prior to 1929, surety underwriters and their customers placed greater emphasis on performance of the work than on payment of bills, though a guarantee of payment for labor and materials was usually included in performance bonds. As a result of the depression, many subcontractors and material men found that the owner's prior claim frequently lessened the value of the payment guarantee. Through the efforts of the National Association of Credit Men and other credit organizations in the building trades, the Miller Act, providing separate performance and payment bonds on federal construction, was enacted by Congress in 1935.

Since that time surety companies have consistently recommended the use of a separate payment bond with direct right of action by the creditors, as a convenient and effective means of guaranteeing to owners and creditors alike that the general contractor will pay obligations he has incurred in performing the contract. A more general use of the payment bond on public and private work in addition to the usual performance bond, will be an important contribution toward stabilizing the construction industry. This benefit will occur not merely by imposing a financial penalty on a surety that fails to verify a contractor's payment record, but by reducing the cost of construction through the elimination of credit losses to subcontractors and material men, thus relieved of the need of providing for such contingencies in their aggregate contract price.

General contractors must be assured of protection against having to pay for the same work two or more times, or against the default of their direct creditors, which likewise is most satisfactorily done by requiring their subcontractors to furnish surety bonds in favor of the general contractor.

Surety bonds provide protection against the consequences of human errors of judgment, normal hazards of the construction business, and dishonesty. But owners and prospective creditors of general contractors must, of necessity, exercise discretion in judging the basic qualifications of the general contractors with whom they do business. Competent and reliable sources of information upon which to base such judgment are available both to owners and to members of the building trades.

HELP IS AVAILABLE

The Bureau of Contract Information, Inc. (1420 New York Avenue, N.W., Washington, D.C.) is a non-profit organization organized in 1929 through cooperation of the bonding business and the construction industry. Its purpose is to make available to awarding officials, both public and private, and their architects and engineers, trustworthy factual data on contractors throughout the United States. Their reports cover:

Performance Records—Types and amounts of contracts completed, indicating the class of work the contractor is competent to perform by experience.

Reliability—History of partners or officers, which usually discloses any previous association with a defaulting contractor.

Financial Condition—Not including financial statements, but showing the ability of the contractor to finance contracts from his accumulated resources and credit standing with banks and trade sources.

Bonding Record—Past performance in fulfilling responsibilities under surety bonds.

Special Investigations—Of bidder's qualifications to perform work for which proposals may be pending award.

Reports from the Bureau of Contract Information may be obtained by owners and their architects and engineers, upon request, without charge or obligation. This service has been of inestimable value to awarding officials on both public and private work for the past fourteen years, particularly in the wartime emergency.

The most satisfactory sources of credit information available to subcontractors and material men are "friendly" sources, such as banks, bonding companies, and local credit associations affiliated with building trade organizations. Such sources maintain extensive facilities for investigation and reporting of information on the record and qualifications of general contractors throughout the country. Their experience in interpreting the facts disclosed by their investigations is likely to be of value to their customers.

Some surety underwriters regularly check the relations of their general contractor clients with all the subcontractors used on completed contracts. This practice has been of great value in demonstrating the superiority of some contractors' business methods over those of some competitors—to the benefit of those contractors thus shown to be more deserving of confidence.

Regional Development of the Missouri Basin

A Multiple-Purpose Plan by the Bureau of Reclamation

By HARRY W. BASHORE, M. AM. SOC. C.E.
COMMISSIONER, BUREAU OF RECLAMATION, WASHINGTON, D.C.

HARNESSING the waters of the Missouri River and its tributaries in a manner that will benefit the nation as a whole is the plan proposed to Congress by the Bureau of Reclamation. Such development would provide 90 multiple-purpose reservoirs with a total capacity of 63 million acre-ft. Proponents of this plan envision an agricultural and commercial growth in the area which would provide support for an additional 650,000 people. In this article Mr. Bashore estimates that crop values in the area will be increased by more than 168 million dollars annually, while power, flood control, navigation, and municipal water benefits will total 38 million dollars annually.

FLOOD control and irrigation are the primary benefits contained in the Missouri Basin development plan proposed by the Bureau of Reclamation, through the Department of the Interior. Flood waters, which annually take a huge toll of human life and property in the Missouri Valley, would be stored to irrigate 4,760,000 acres of agricultural land. Supplemental water would be supplied to 547,000 acres now inadequately irrigated.

In addition to flood control and irrigation, other benefits from storage in these reservoirs would include improved navigation on the lower river and power generation on the upper river and some tributaries. An adequate supply of water for municipal, industrial, wild-life, and recreational uses would be assured and silt control provided.

The plan of the Bureau of Reclamation fully recognizes the needs of navigation downstream on the Missouri River. The proposed reservoirs would provide in the lower river a uniform flow for navigation purposes of approximately 17,000 cu ft per sec during the navigation season. Navigation could be better served by complete regulation of the stream. Regulation would also provide a uniform power output.

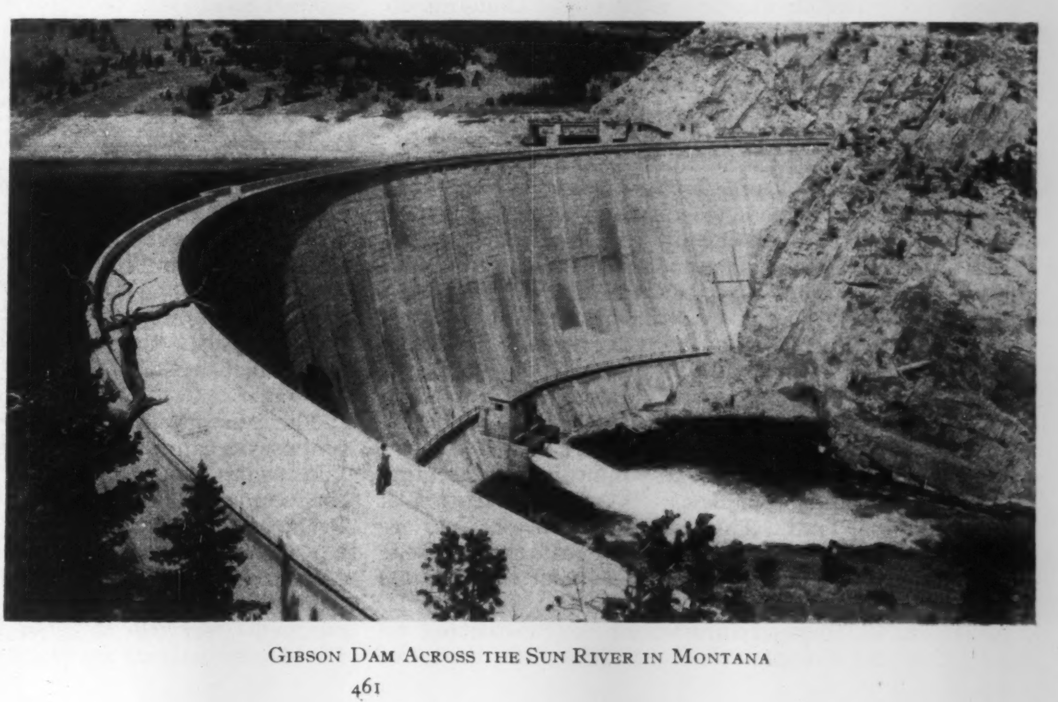
Construction of 17 power plants with an aggregate installed capacity of 758,500 kw is also proposed. The low-cost power from these plants, carried over a network of transmission lines, would bulwark the entire region with small industries, many of them based on the processing of agricultural produce from irrigated lands. Mineral developments would be advanced. Light and energy would be available to farm homes and nearby towns, through cooperation with the Rural Electrification Administration.

In the plan, the Missouri River Basin is subdivided into six areas, as shown on Fig. 1. These subdivisions extend from the arid through the semiarid, and into the subhumid and humid regions. Even in the humid areas, the rainfall is erratic and not sufficient to guarantee economic security from the cultivation of the land. Droughts, floods and human misery are constantly being written into the records of this region.

Each of more than 150 projects proposed for ultimate construction by the Bureau of Reclamation is justified by the public benefits the plan as a whole would yield, not only to the Missouri Basin, but to the nation. The disastrous effects of drought and floods are not confined to the states of the basin. They are reflected in national commerce by the loss of hundreds of millions of dollars worth of material and articles which would be exchanged annually between residents of these states and other sections.

The national significance of these developments was stressed by Secretary of the Interior Harold L. Ickes, in a recent report to Senator John H. Bankhead, chairman of the Senate Committee on Irrigation and Reclamation. In this report Secretary Ickes recommended the enactment of Senate Bill 1915, which authorizes the construction of 32 irrigation and multiple-purpose projects as the initial phase of the Bureau of Reclamation plan. In his report, Secretary Ickes said:

"The Reclamation plan, incorporated in Senate Document 191, shows that the droughts of the last decade cost governmental agencies, principally federal, a total of $1,246,557,087, and that these expenditures were inadequate to the needs of the region since tens of thousands of families, nevertheless, were forced to migrate from



GIBSON DAM ACROSS THE SUN RIVER IN MONTANA

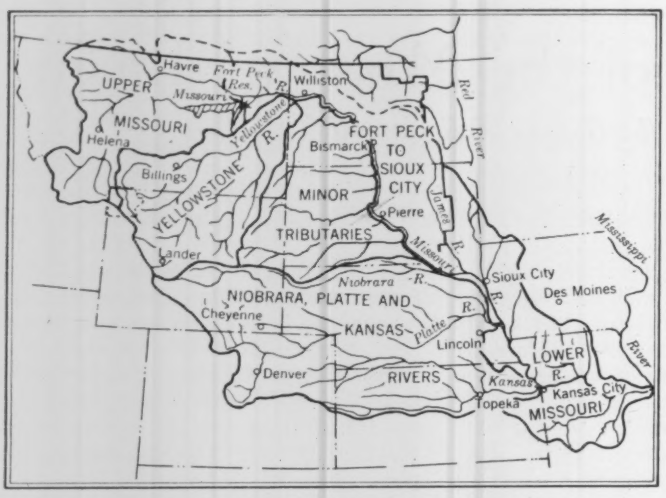


FIG. 1. PLAN DIVIDES MISSOURI BASIN INTO SIX PARTS

their land and homes. The works that are proposed in the entire comprehensive plan would cost $1,257,654,700, and the annual benefits would exceed 2.57 times the annual costs."

Reservoirs to be constructed in the Missouri River Basin range in capacity from a few thousand acre-feet on the tributaries to 19,600,000 acre-ft at Oahe Dam, which the Bureau of Reclamation proposes to build on the river, eight miles above Pierre, S.D. This great reservoir is a revealing example of a multiple-purpose project. It would reduce the silt load in the lower river, catch peak runoffs to prevent floods, furnish water for dry-period navigation of the lower river, generate power, and irrigate 750,000 acres in the James River Basin.

Besides the Oahe and other developments on the main stream, a large number of reservoirs would be provided on the tributaries of the Missouri River in Montana, North Dakota, South Dakota, Wyoming, Nebraska, Colorado, and Kansas. Water releases from the upper reservoirs would be governed generally by irrigation needs, and those from the lower reservoirs by navigation needs.

Details of the plan, including descriptions of the projects, their locations, and purposes are given in Senate Document 191, which was presented to the Congress on May 5, 1944. The following general survey presents a few of the outstanding construction features of the plan.

The Yellowstone River Basin, where 728,000 acres could be brought under irrigation and supplemental water made available to 327,000 acres of land now inadequately irrigated, is the first subdivision of the Reclamation plan. Irrigation projects along the Yellowstone River would be located on flood plains or terraces rising from 25 to 300 ft above the present river level. They would be scattered along the valley in small units separated by long stretches of rugged uplands. Other potential units would be located on all the principal tributaries.

A total of 27 reservoirs, with an aggregate capacity of 4,285,200 acre-ft, is proposed for the Yellowstone River Basin. Nine power plants, with an annual firm production of 1,509,200,000 kwhr, are also contemplated.

In the Big Horn Basin, which is part of the Yellowstone subdivision, located in Wyoming and Montana, 11 reservoirs would be constructed for the irrigation of 350,000 acres of land. Thirteen individual projects are proposed, with development of power at three of the major dam sites. Boysen, with a capacity of 730,000 acre-ft, is the key reservoir in this area.

A system of 10 reservoirs would be constructed on the Powder and Tongue rivers, which are also a part of the Yellowstone Basin. On the Powder, approximately 100,000 acres of new land would be irrigated and additional supplemental water provided for 42,000 acres. A new reservoir on the Tongue would furnish supplemental water for the area around Sheridan, and in Montana 22,000 acres of new land would be irrigated from a reservoir already constructed.

Upward of 20 reservoirs would be constructed on the Upper Missouri, above the mouth of the Milk River in Montana. The principal one of these is at Canyon Ferry Dam. This dam would regulate the flow to protect existing irrigation, provide sufficient storage for additional acreage, and produce power. There are some 350,000 acres above Canyon Ferry awaiting irrigation service, including areas requiring supplementary water supplies. On the Upper Missouri, between Great Falls and Fort Peck in Montana, is the large Marias Project consisting of 120,000 acres, which would include the Tiber Reservoir of 915,000 acre-ft capacity.

One of the most important subdivisions lies between the Fort Peck Dam and Sioux City. In this area is North Dakota, where 1,266,400 acres would be benefited by irrigation. Practically all this land is in a territory where irrigation has not been practiced. Agriculture is precarious here because of the erratic and scanty rainfall and periodic droughts. These 1,266,400 acres would be irrigated principally by the diversion of water from the Fort Peck Reservoir, which was constructed primarily for navigation by the U.S. Army Corps of Engineers. (Other reservoirs would be constructed downstream on the Missouri, under the Bureau of Reclamation plan, to take care of navigation requirements now served by the Fort Peck Dam.)

By using water of the Missouri River stored in and regulated by the Fort Peck Reservoir, irrigation would be provided for the Missouri-Souris project in Montana and North Dakota. This project contemplates the irrigation of 1,403,400 acres—a larger area than is embraced in the great Columbia Basin project of the Bureau of Reclamation in the State of Washington. About 330,000 acres are in Montana and more than 1,000,000 in North Dakota.

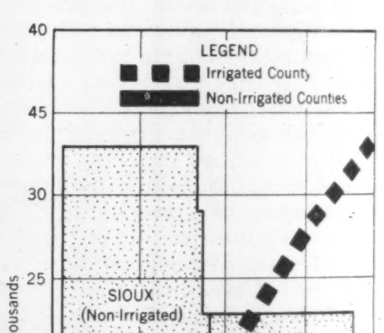


FIG. 2. POPULATION TRENDS IN AREAS OF NEBRASKA—BUREAU OF RECLAMATION STATISTICS

The full capacity of Fort Peck, however, would not be used for irrigation. Of the 18 million acre-ft of capacity, 10 million would remain to supplement navigation requirements in the lower reaches of the Missouri.

The Bureau plan proposes a canal to take water out of the river below Fort Peck, and divert it to a reservoir in Montana, from which it would be pumped over the Divide to irrigate the Dakota lands. The return flow from the irrigation of these lands would be backed up in the Souris River and then diverted to the Sheyenne and James rivers in North Dakota for further irrigation, municipal water supplies, and other purposes. One of these purposes is to restore the level of Devils Lake, a large recreational and fishing center in North Dakota, where the water surface has been receding for many years. In addition to the restoration of this lake and irrigation, the Missouri-Souris Project would supplement the municipal water supplies of 19 towns in the Sheyenne, Red, and James River valleys in North Dakota, South Dakota, and Minnesota.

Good Sagebrush Lands Which Can Be Brought Under Cultivation with the Extension of Irrigation

During the last ten years, these 19 towns, which include Fargo and Grand Forks in North Dakota, were annually faced by severe shortages of municipal water both for drinking and for sanitary purposes. The Bureau's plan would prevent a recurrence of these shortages.

Outstanding construction features of the northern division of the Missouri-Souris Project would include the main canal with a capacity of 6,200 cu ft per sec. This canal, which would be operated throughout the year, would divert from the Missouri about 4 miles below the mouth of the Milk. Only 99,600 acres would be irrigated directly from the canal. The remaining water would be delivered to Medicine Lake Reservoir, which would have a live storage capacity of 1,614,000 acre-ft.

Other reservoirs, pumping plants, and power plants would be constructed as additional features of the project. One of the main power plants is that at the Crosby Reservoir, North Dakota, with an installed capacity of 71,600 kw. The power will be used largely for pumping.

Although North Dakota would receive many major benefits from the Missouri-Souris Project, the irrigation needs of South Dakota have also been given full consideration in the plan. The Oahe Dam, one of three large dams planned on the main stem of the Missouri in South Dakota, is designed primarily for navigation purposes as a substitute for the capacity in Fort Peck Reservoir used for irrigation. It would also store water which could be diverted by a canal and a 110-ft pumping lift across the Divide to the James River area in South Dakota, where the Bureau plans to irrigate 750,000 acres.

Power required to pump the water from the Oahe Reservoir would be developed by a drop at the eastern end of the canal, which provides all the energy needed for the lift. The remaining water would be passed through the dam and through a power plant of 150,000-kw capacity. This power plant, in conjunction with the Big Bend and Fort Randall plants downstream, would develop a total of 177,500 kw of firm, continuous power.

The Big Bend power plant would be located at a low dam—only 40 ft high—on a long bend in the river, with a 22-ft fall. This plant was inserted in the plan to use all the possible drop in the river for power purposes.

The reservoir at Fort Randall would re-regulate the flow of the stream to meet the navigation requirements in the lower river, where navigation is practised only from March 15 to November 15. Therefore, a large amount of water is needed during the navigation season, and a very small quantity is required during the winter months. During the non-navigation season, it is estimated that about 5,000 cu ft per sec would be required to furnish water for municipal purposes for all the towns and cities along the Missouri River.

The minor western tributaries, from the Little Missouri to the White River, traverse the heart of the northern portion of the "dust bowl." Here would be located 15 reservoirs with a total capacity of 1,237,000 acre-ft. In developing this now sparsely settled region in North Dakota, South Dakota, and Wyoming, 212,980 acres of new land would be irrigated and supplemental water would be supplied to 11,300 acres, while flood control would also be provided by the reservoir.

Flood control on the lower Missouri is recognized as a most critical problem and is a major objective of the Bureau's plan. The Bureau proposes storage on the main stream which would be adequate to control floods such as occurred in the Omaha and other areas in 1943. This capacity would be supplemented by flood control facilities on the tributaries and the upper reaches of the Missouri. Studies show that the 1943 flood could have been regulated to a safe capacity in the river channel at Omaha and Kansas City with only 2 million acre-ft of storage. The Bureau's plan provides about $3^1/_2$ million acre feet on the main stream to control floods such as occurred in 1943, in addition to the incidental flood control provided on all of the tributaries and the upper reaches of the Missouri River.

The Lower Missouri subdivision includes those parts of the Missouri River Basin lying between Sioux City and the mouth of the Missouri and the basins of the tributaries which enter from Iowa and Missouri. Water in this area is used only for navigation, municipal supplies, and sanitation purposes, while the control of river flow for flood protection is a paramount need. Functions of the Department of the Interior, as stated in Senate Document 191, have not ordinarily included studies of water uses for navigation. In the discussion of water utilization problems in this portion of the Missouri River Basin, documents and reports prepared by the Corps of Engineers have been drawn upon and have been supplemented by studies made by the Bureau of Reclamation, where works proposed for multiple purposes would affect or modify the proposals made by the Corps of Engineers. The effects of upstream regulation for irrigation, flood control, power production, and other miscellaneous uses, will so alter the regimen of the stream between Sioux City and St. Louis that the effect on navigation possibilities must be fully considered.

The situation in the Lower Missouri area is affected by the control in effect or proposed for the Platte, Niobrara,

Soil Conservation Service

REPUBLICAN RIVER FLOODS DISCHARGE WATER NEEDED LATER IN THE SEASON

and Kansas River basins, which form a subdivision in the Reclamation plan. In the Platte River Basin, the major developments in the Reclamation plan include eight reservoirs with nearly 2,500,000 acre-ft of capacity. These are located on the South Platte, the North Platte, the Loup River, and its tributaries. Irrigation service would be provided for a million additional acres in Nebraska.

TABLE I. PROPOSED IRRIGATION DEVELOPMENT IN THE MISSOURI RIVER BASIN, IN ACRES

STATE	NEW LAND	SUPPLEMENTAL SUPPLIES
Montana	967,130	346,800
Wyoming	281,560	167,400
Colorado	101,280	1,719
North Dakota	1,266,440	......
South Dakota	961,210	11,300
Nebraska	989,445	19,930
Kansas	193,335	155
Total	4,760,400	547,304

In addition to the storage on the main stem and upper tributaries, the plan also provides for flood control below Kansas City through multiple-purpose reservoirs on the Republican and other tributaries of the Kansas River. A total of 3,200,000 acre-ft of storage is called for in 14 reservoirs in the Kansas River Basin, where about 285,000 acres in Kansas and Nebraska could be irrigated.

Power developments in the Platte River Basin rest on readjustments of storage to protect existing hydroelectric developments. An additional reservoir would be constructed and transmission interconnections made with the general Missouri River system provided for in the Reclamation plan to replace power that might be affected by the diversion of water for additional irrigation in the Loup and Lower Platte valleys.

TABLE II. POWER PLANTS INCLUDED IN MISSOURI PLAN

NAME	INSTALLED KILOWATTS
Montana:	
Lyon	23,500
Canyon Ferry	35,000
Portage	20,000
Mission	50,000
Yellowtail	75,000
Fort Peck	35,000
Subtotal . . . (6)	238,500
Wyoming:	
Kortes	30,000
Boysen	10,000
Kane	30,000
Hunter Mountain	12,000
Wyoming (cont'd):	
Thief Creek	60,000
Sunlight	20,000
Bald Ridge	30,000
Tongue River	3,000
Subtotal . . (8)	195,000
South Dakota:	
Oahe	150,000
Big Bend	75,000
Fort Randall	100,000
Subtotal . . . (3)	325,000
Total for Basin (17)	785,500

The 17 power plants in the Missouri River system would be capable of generating 3,809,200,000 kwhr of firm energy annually. The interconnection would be through high-voltage transmission lines to serve agricultural, mining, and other industries, as well as rural and municipal uses.

The combination of power development with flood control, irrigation, and other purposes contributes to the maximum conservation, control, and use of the water resources of the Missouri River Basin. The 45,000,000 acre-ft of storage in the 90 proposed new reservoirs in the Reclamation plan, together with about 18,000,000 acre-ft of capacity in the Fort Peck Reservoir, is $1^1/_2$ times the total average annual flow of the Missouri at its mouth.

Table I shows potential irrigation by states in the Reclamation plan for development of the Missouri Basin. Table II lists the power plants outlined in the plan.

Translating the statistics of irrigated acreage into new homes, increased population on farms and in towns, new jobs, and a permanent sense of economic security, the Reclamation plan for the control and use of the waters of the Missouri River Basin has special significance in America's postwar period.

Fifty-three thousand farms of 90 acres each would be created through the irrigation of 4,760,400 acres of new land, and the 547,300 additional acres provided with supplemental water. Assuming an average of four persons per farm, rural population would be increased by 212,000. For every person on an irrigated farm, two additional individuals find a means of livelihood in nearby towns and cities, thus making a prospective increase in total population of 636,000 in the Missouri Basin from irrigation development alone. Trends of population in irrigated and non-irrigated areas are shown in Fig. 2.

Nearly 600,000 persons from the armed forces and war industries will be seeking employment in the states of the Missouri River Basin during the early part of the postwar period. Approximately 250,000 man-years of employment would be afforded by the construction of the initial group of more than 30 projects recommended to Congress by Secretary Ickes. This means that if it would be possible or desirable to complete the projects in one year, there would be work for 250,000 men. These projects could be got under way quickly and would provide early benefits through flood control and irrigation.

Not all the workers would be employed on the various projects. Many jobs would be available in other sections of the country—in factories producing the necessary equipment and materials, and in the transportation of these supplies to the projects under construction. Employment resulting from the proposed construction program would, therefore, have national scope.

In summation, the Bureau of Reclamation's plan for harnessing the great Missouri River would bring lifelong deliverance and economic security to those who have tragically suffered from floods and droughts, and would continue the expansion of this nation through the development of an area rich in natural resources.

A Plan for the Regional Developments of Tomorrow

A Statement of the Policy of the National Democratic Candidates

By HARRY S. TRUMAN

SENATOR FROM MISSOURI, DEMOCRATIC CANDIDATE FOR VICE PRESIDENT OF THE UNITED STATES

"HOW can the federal government help rebuild postwar America?" This is the question President Roosevelt has answered in his messages to Congress initiating great regional developments. In addition, it is the stated policy of the Democratic candidates that the federal government shall help redesign our communities, providing facilities which the communities themselves cannot provide. In this article Senator Truman directs attention to the task ahead in planning for a great new period of productivity following the war.

NO one doubts that industry, agriculture, and labor will convert the vast energies of war into a great stream of peacetime goods. But as a national community we must also harness great new productivity to rebuild America—replant our forests, reclaim our lands, rebuild our roads, to replenish our natural wealth, and go on to make new communities fit for all.

This is the postwar challenge we face as a people. And government, concerned with the general welfare, must do its part both in stimulating and in balancing this rebuilding so that it will not be lopsided or uneven, so that all sections of the country and all the people will share fully in its benefits.

Giant power-flood-reclamation projects are the key to regional development. The TVA has demonstrated, both in war and peace, what strides can be taken by entire states and regions through such coordinated regional programs. Other such projects—on the Columbia, the Arkansas, and the Missouri rivers—have already been proposed to the Congress by President Roosevelt. And more will follow. For those sections of the country whose resources and manpower were never fully used, whose industry and agriculture lagged, have now moved ahead so far in the war that they will not turn back.

Such giant projects will provide the power needed for the continued growth of local industry and agriculture. They will permit the decentralization of many industries, and the growth of new industries which require a source of cheap power in order to use to the full the natural resources of these regions.

Such regional developments will also further vast reclamation and land development programs. Our dwindling supply of lumber in wartime only emphasizes the reforestation long urgently needed. We shall see soil conservation and soil improvement projects, control of flood waters, improved drainage and diking, and irrigation for farm lands now drying up. These programs have already been proposed by the Department of the Interior and the Department of Agriculture.

Linking these great regional developments will be new super-highway systems, improved intermediate roads, and trunk waterways. Many of our roads have gone without repairs during the war. Many of them will be inadequate for the thunder of postwar traffic. Road-building programs, worked out with the states, have already been presented to the Congress.

No one can yet foresee the dimensions of our postwar aviation. Many of the forecasts are far too conservative. But all are agreed that the progress and usefulness of civil aviation will depend on the number of well-equipped and fully serviced airports that are available all over the country. Programs for building these are already under way, some in inaccessible sections that will be brought days closer to our urban centers of distribution.

Each of these programs requires the closest cooperation between state and federal governments. They must also be integrated with private plans—improved transportation and bridges, elimination of grade crossings, the growing civil aviation industry. But in certain directions the federal government must take the lead. For the benefits of great regional developments cross state boundaries and they need not be held up by inadequate state funds.

Industry and agriculture will benefit directly from every one of these regional developments—as they have already. Super-bombers could never have been produced in quantity were it not for Bonneville, Grand Coulee, and TVA. The output of farms in the Tennessee Valley is several times greater than in pre-TVA days.

But the conservation and better use of our natural resources made possible by these regional developments must also contribute directly to the well-being of the individual citizen in his local community. And here is a second great task for government—the task of helping, usually indirectly, to rebuild our communities so as to make them better places to live and work and play in for the individual.

This task of redesigning our communities, to make them richer for living, demands the combined efforts of private, public, local and federal agencies. The federal government can strike a balance among the communities, guide the efforts of other agencies, and supply what none of them alone can.

The President has already pointed the way in his call for more rural schools and aid to rural education. The government can go further in wiping out illiteracy and poor health in the under-privileged areas—by encouraging the development of libraries, hospitals, and medical centers. It will also aid in developing farm-to-market roads, to lower the cost of farm distribution.

The heart of a community is its housing. If we are content to grind out millions of new homes by old methods and sprawl them through the suburbs, we shall leave untouched a core of obsolescence and blight. Low-cost, well-built houses, community facilities, and recreational areas are needed. The government can help make these possible by fitting community plans into broader regional developments. The government, in short, can supply those elements of community redesign which the unaided individual, the private builder, the local community, and often even the state itself, cannot.

This twin program of regional development and community redesigning will work. It will give elbow room for industry and agriculture to expand and flourish in new sections. It will conserve our resources. It will encourage private industries to give a great forward push to undeveloped sections. Most important, it will secure the greater welfare of the individual citizen.

Public Works Planning as Aid to Overall Postwar Employment

A Statement by a Republican Congressman

By EVERETT M. DIRKSEN
CONGRESSMAN FROM ILLINOIS, REPUBLICAN

ALTHOUGH public works do not fill the place of permanent jobs, immediate planning is necessary for two purposes: to build needed works when materials and manpower are once more available; and to create a schedule of desirable public works to be undertaken during periods of unemployment. An overall analysis is here presented by Congressman Dirksen, who draws upon the policy stated and restated by the Republican candidates.

PLANS for needed public works should go forth without delay until there is assurance that every project, balanced in its relationship to the needs of our nation, will be ready to start when men and materials are once more available. Administration of these public works can and must be undertaken as far as possible at the state level. No function of the governments of the states is more important than this safeguard against the evils of unemployment. We must husband our resources, even as we contribute our utmost to the war, so that as millions of young men return to their homes from far-flung battlefields, they will find conditions under which there will be jobs for all.

A sound and harmonious program to include soil, forest, water, and wild-life conservation and development is imperative. Plans for millions of dollars worth of works to be built in the postwar period have already reached the blueprint stage. Yet there is much to be done before we can rest from making provisions for the future. It is significant to note that, as was shown by a recent report of the Federal Works Agency to a special House committee, two-thirds of all the postwar public works already brought to blueprint stage are in five states: New York, California, Illinois, Michigan, and Ohio. All these states have Republican governors and it is perhaps worthy of special attention that the governors of two of them are the Republican candidates for president and vice-president—Governor Thomas E. Dewey of New York and Governor John W. Bricker of Ohio.

Actually we have no fear that American enterprise can not provide jobs after the war. For there will be lots to do once we stop building tanks and guns. Housing is but one example of the unsatisfied demands of the American people. If we simply build the homes needed after the war it will keep millions of men employed for years. It has been estimated that, to catch up with the demand for homes, over a million units a year will have to be constructed for years to come.

When peace comes, a great responsibility will fall upon the nation—a responsibility it must be able to meet without delay—to help industry convert itself to production for peace. A part of this responsibility may be discharged by the immediate launching of needed and deferred public works. As the readjustment takes place, we will find that unemployed capital is today about the same in character as it always has been. It will go to work if it can find a place to work with a reasonable chance of not losing both its job and itself.

The Republican platform and the 14-point program adopted by the 26 Republican governors subscribe to a comprehensive program of public works. Included are soil, forest, water, and wild life conservation and development, sound irrigation projects, and provisions for construction and maintenance of highways.

The federal government should develop a program for flood control, inland waterways, and other economically justifiable public works, and prepare the necessary plans in advance so that construction may proceed rapidly in the event of an emergency and in times of reduced employment. We urge that state and local governments pursue the same policy with reference to highways and other public works within their jurisdiction.

We favor a comprehensive program of reclamation projects for our arid and semi-arid states, with recognition and full protection of the rights and interests of these states in the use and control of water for present and future irrigation and other beneficial consumptive uses.

A policy of cooperation, coordination, and understanding among various federal agencies and the states can and must be established. Especially is this true in the case of the development of our water resources. This policy can, without conflict or confusion, develop water for present and future irrigation, waterways, power, flood control, and other beneficial uses.

This policy of cooperation should be extended in the immediate planning of postwar public works. This preparation of plans is a necessary part of the administrative work of government units—whether federal, state, or local, depending upon the scope of the project.

It should be clearly recognized that the building of public works does not fill the place of permanent jobs, but is only a material aid to the overall employment program in which labor, industry, agriculture, and government cooperate.

When and if, in case of national necessity, there are public works which may properly be the province of both federal and state or local governments, then grants in aid should be made by the federal government to states, or through them to their local governments, without creating conditions which invade the authority of the state or local government.

State governments have, generally, been able to conserve resources during this war. The states should recognize their responsibilities and use their reserves before asking federal aid on state public works.

Federal aid in building and maintaining highways, as carried out under Republican national administrations and since continued, is a sound and comparatively harmonious program. In principle, taxes collected by the federal government from gasoline and from motor vehicles should be wholly devoted to highway purposes and distributed equitably among the states.

Actual construction by the state governments has demonstrated how eminently successful such cooperative enterprises can be when state responsibility is recognized by the federal government and accepted by the states. This practice should be continued.

Engineering Aspects of Mosquito Control

II. Malaria Control in War Areas

By Mark D. Hollis

Senior Sanitary Engineer, U.S. Public Health Service; Officer in Charge of Program, Malaria Control in War Areas, Atlanta, Ga.

EXTENSIVE wartime efforts to combat malaria lead to the conclusion that this widespread disease can be brought under control within five years and at an annual expenditure of perhaps 10 millions. Some 1,200 war establishments were treated by various methods and with varying success. For example, in 1943, airplane dusting killed 97% of the mosquitoes attacked. In addition hundreds of miles of major ditches were built, using dynamite where possible, as the most economical method. Engineering and other difficulties, together with the means adopted for their solution, are also given in this interesting paper, originally delivered before the Society's Sanitary Engineering Division.

MALARIA, long the No. 1 disease of the world, already is labeled the No. 1 disease of World War II. In the continental United States, it has been gradually declining since 1880, interrupted by cyclic rises at approximately seven-year intervals. Following the last peak in 1935–1936, malaria morbidity declined rapidly to the present level, which is the lowest in history. Endemicity in the United States is broadly confined to an area south of the latitude of Washington, D.C., and east of the longitude of Austin, Tex., and to small zones in the valleys of California, Oregon, and New Mexico.

With a large percentage of military and industrial mobilization occurring in existing or potential malarious areas, state and local health authorities were faced with a control task the difficulty of which was accentuated by the loss of technical personnel to the armed forces. The resources of these health agencies were supplemented as required to accomplish the task when, in March 1942, the Public Health Service was provided with funds and charged with the responsibility of controlling the production of mosquito vectors around major war establishments.

CONCERTED EFFORT IN THE UNITED STATES

The resulting program—Malaria Control in War Areas, a joint undertaking of the U.S. Public Health Service and the several state health departments—is designed to reduce the potential hazard of malaria transmission in extra-cantonment zones around military areas and essential war industries. It is emergency malaria control—a program of preventive medicine. It complements similar activities of military authorities within the reservation limits. The guiding policy is to provide effective protection for war personnel with a minimum expenditure of manpower and material. Control of merely obnoxious mosquitoes is specifically excluded.

During 1942, operations were carried out in areas contiguous to 900 Army, Navy, and other war-connected establishments. By 1943 the number of such establishments had increased to 1,200, comprising work in 320 counties of 20 states, the District of Columbia, and Puerto Rico. In addition, 12 cities in five states and the Territory of Hawaii operate anti-*aedes* projects (*Aedes aegypti* in the United States, *aegypti* and *albopictus* in Hawaii) to control or prevent outbreaks of dengue and yellow fever.

Surveys have been made of areas adjacent to military establishments receiving concentrations of malaria carriers returning from overseas, including military hospitals, camps for prisoners of war, and debarkation centers. Where even moderate densities of malaria vectors occur, control operations will be instituted or intensified. At other points, entomological surveillance will be maintained. This will add about 400 new projects in 1944.

In organizing and developing the program, Louis L. Williams, Jr., Medical Director of the U.S. Public Health Service, utilized fully the counsel of other leading malariologists in formulating major policies. Epidemiological guidance is furnished by medical officers on the headquarters staff, and at the state level by physicians of the state health departments. Other professional personnel include 125 engineers and 80 entomologists, mostly reserve officers on active duty. The number of non-professional personnel and laborers fluctuated between 2,500 and 4,000, with an annual average of 3,200. Expenditures total about $10,000,000 per annum, of which some $8,500,000 are federal funds.

The headquarters office in Atlanta, Ga., exercises, through the state health departments, overall direction of policy and administrative control. An administrative officer and clerical aides are assigned to each state. No clerical force is maintained at the "war area" level. Administrative forms are kept to a minimum and those necessary are executed in pencil by the area engineer; all administration and compilations are handled by the state and headquarters offices. This procedure eliminates the need in 300 war areas for clerical officers, secretarial help, and such critical materials as typewriters and other office equipment. Direction of the program is in collaboration with the district offices of the U.S. Public Health Service.

The operational unit is the "war area." Based on geographic dispersal, nature and extent of required opera-

Typical Area Suited to Airplane Dusting

Jeep with Power Sprayer in Operation

tions, the 1,200 war establishments are so grouped as to form 300 war areas, each under a supervisor. In major areas this key personage preferably and generally is an engineer.

WIDE ATTACKS WITH LARVICIDES

Control measures involve the mechanics of reducing exposure of the human host to the vector of the disease. Pending discovery of better drugs, chemotherapy and chemoprophylaxis are excluded as control measures. Operations are designed not for permanent eradication of vectors, but to reduce the number of vectors in critical areas below the level of sanitary importance. Hence, the frontal attack is the application of larvicides to breeding areas of the anopheline vector. Where the cost ratio of vector control versus number of persons protected is large, insecticide sprays are used together with mosquito proofing. Pyrethrum sprays of either emulsion or aerosol type are generally employed. Military bivouac camps and small air bases located in areas of extensive vector breeding are examples of localities where this method is applied.

The average larvicidal crew consists of a foreman and four oilers or dusters equipped with a truck. The magnitude of the job in an area determines the number of such crews. Activities incidental to larvicidal operations include minor drainage, brushing, clearing, and removal of emergent vegetation and floatage from ponds and sluggish streams.

During 1943, approximately 2,000,000 gal of oil and over 100 tons of paris green were used for 275,000 acre-treatments of water surface productive of malaria mosquitoes. In the 300 war areas, potential vector breeding grounds exceed 75,000 acres. Entomological surveys and surveillance reduced necessary larvicidal treatment to 18,000 acre-seasons, that is, the number of areas receiving a seasonal average of 15 larvicidal treatments. Since some waters produce vectors only periodically, the total acreage receiving one or more larvicidal applications per season exceeds 25,000. Miscellaneous minor drainage and incidental clearing are integrated with the larvicidal program, as the crews are used on this work when not engaged in applying larvicides.

Larvicides are applied largely with hand sprayers and dusters, of which 3,000 and 1,500, respectively, are in use. Manpower requirements have been reduced on the larger projects by adding 50 power sprayers, 29 water-oiling units, 40 power dusters, and dozens of power mixers. Thousands of hand tools for incidental clearing and drainage are in use. Where conditions indicate, airplanes are employed for dusting. Labor crews and supervisory personnel are mobilized by means of some 700 automotive vehicles.

The resulting overall reduction in anopheline vector density is well illustrated by Fig. 1, in which the highest single resting-place count in each war zone in 1943 was used to compute weekly averages.

During 1942, control work was effective in reducing and maintaining satisfactory low densities of anophelines in approximately 92% of the 900 war establishments under protection. For the remaining 8%, during certain periods the density may have been high enough to cause malaria transmission in the presence of sufficient human carriers. This 8% was distributed throughout the malaria belt, thus indicating local difficulties and not general technical failures in any one state. A preliminary summary of 1943 data shows that the percentage of satisfactorily controlled areas is approximately the same as for 1942.

In 1943 eight airplane dusting projects were operated in six states. Approximately 400,000 lb of a 25% paris green mixture were applied over 66,000 acres. Analysis of seasonal figures for these dusting jobs shows a net average cost of $1.12 per application per acre treated. Based on the ratio of adult female mosquitoes taken within and outside the control limits, reduction in *Anopheles quadrimaculatus* varied from 90 to 99%, with an overall average of 97%.

Larvicidal operations over the past two seasons required an average of 20 gal of oil (Diesel No. 2) and 8.5 man-hours per acre treated. For paris green, the per acre figures were 1.1 lb and 2 man-hours. Including all expenditures, the man-hour cost for the entire program averaged about $1.00. Of the total 1943 appropriation, approximately 80% was for personal services; 15% for supplies, equipment, and contractual services; and 5% for miscellaneous (rent, utilities, travel, etc.).

Major drainage projects are prosecuted: (1) where an effective larvicidal program is infeasible, (2) where such work can be amortized within five years in terms of other practical control methods, and (3) where critical manpower shortages parallel the mosquito breeding season and winter drainage will materially reduce summer manpower requirements. Inauguration of any major drainage work is contingent upon the availability of man-

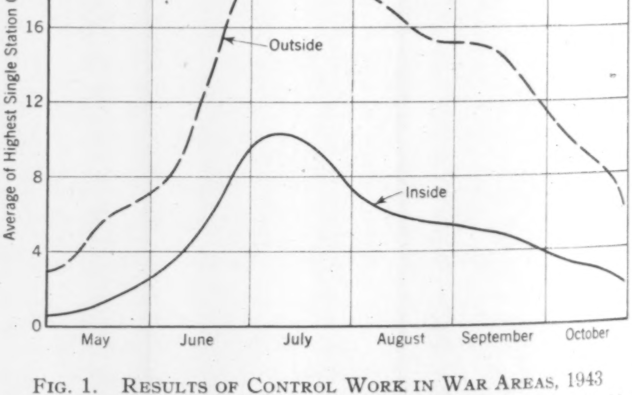


Fig. 1. Results of Control Work in War Areas, 1943
Densities of Malaria Vectors in Three Main Spheres Taken Inside and Outside of War Establishments

power and equipment—considered in relation to other local urgent war needs. Installation of permanent ditch linings is restricted to systems where the hydraulic gradient requires the use of lining, or where the ditches form an integral part of a permanent anti-malarial drainage system of an established military camp or community. In the case of communities, the necessary materials must be provided from non-federal funds. To make full and continual use of limited automotive equipment and professional personnel, major drainage work is accomplished largely during the winter season.

Approximately 300 miles of major ditches have been constructed, involving an excavation in excess of 1.5 million cu yd. About 60% of this work was accomplished with hand tools, 30% with dynamite (250 tons), and 10% with heavy equipment. Dynamiting is by far the most economical method for constructing a ditch through a mucky swamp where the ground is full of roots, logs, and stumps. Under such conditions the average cost per cubic yard is approximately 25 cents. Total excavation by dynamiting has been 500,000 cu yd, requiring approximately the same number of pounds of 50% dynamite. Fills are used to a limited extent—thus far about 100,000 cu yd. Ditches totaling over 25,000 lin ft in length have been permanently lined. Eight thousand lineal feet of subsurface drains, of open-joint tile or French type, have been placed. Drainage operations have eliminated 10,000 acres of breeding surface, most of which could not have been adequately controlled by practical larvicidal operations. Resulting reduction in larvicidal work through economical drainage made it possible to absorb the additional control created by new war establishments without an appreciable increase in total personnel.

SHORTAGES OF FACILITIES

Among the difficulties encountered, the extreme paucity of experienced engineering personnel has been of major concern, 80 reasonably well trained engineers having been released to the armed forces during the past two years. Admittedly, in most of the overseas theaters of operation malaria control problems are of greater magnitude and importance than in the continental United States. Since the supply of experienced personnel is essentially exhausted, recruits are given a two-weeks' intensive didactic training course in Atlanta before assignment to field duty. This course, utilizing motion pictures, slides, and other pictorial and printed material, has been developed almost to the point of self instruction, thus preventing serious interruption of the headquarters staff by the continual arrival of replacements.

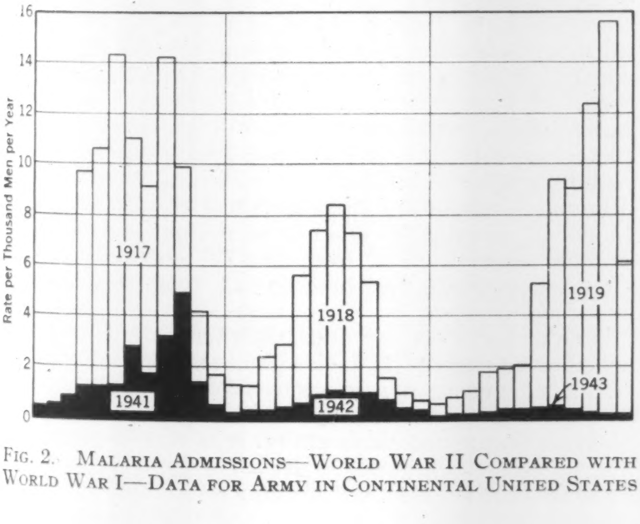
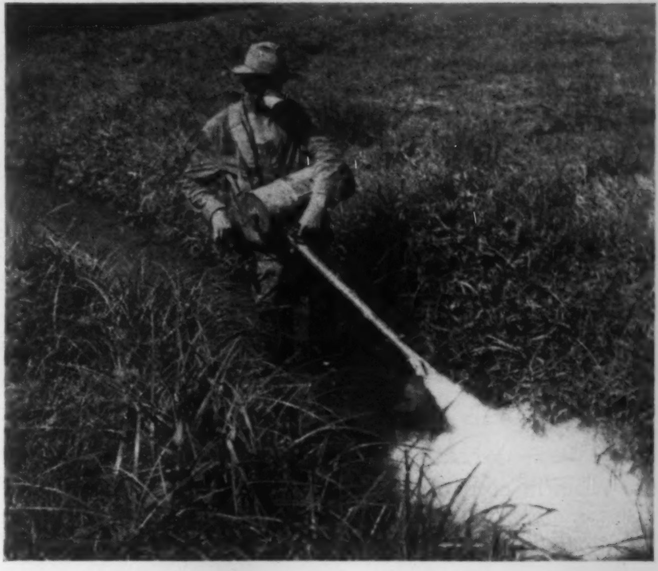


Fig. 2. Malaria Admissions—World War II Compared with World War I—Data for Army in Continental United States



Usual Larvicidal Operation—Paris Green Being Applied by Hand Duster

In some categories, equipment and material shortages have been partially eased by securing over $500,000 worth of used surplus from curtailed governmental agencies. Items obtained include 35,000 pieces of larvicidal equipment and hand tools, 480 automotive vehicles, thousands of pairs of rubber boots, and some heavy equipment.

In the present war, the degree of necessity, together with the availability of manpower and materials, has replaced the dollar sign in determining justification for control projects and extent of operations. In areas where the malaria hazard is of questionable significance, entomological surveillance replaces costly control operations. As a safety factor in the event of an actual or threatened local outbreak, mobile units are available immediately for emergency control operations.

Further conservation of manpower and material is secured through the practice of species sanitation. Three decades ago, reduction of malaria vectors was accomplished largely by general mosquito control. Practices followed in World War I contributed one forward step in that they prescribed controlling only waters productive of anopheline mosquitoes. It is now generally agreed that in the continental United States, out of the 12 species of the genus *Anopheles* capable of transmitting malaria under laboratory conditions, only three—*A. quadrimaculatus* in the Southeast, *A. freeborni* in the Far West, and *A. albimanus* in the Rio Grande Valley—are significant vectors in nature. Hence the concept has arisen of "species sanitation," or concentration on the particular anopheline species which carries malaria in a given area.

By intelligent entomological surveys, large acreages of standing water can be eliminated from consideration. This is particularly significant in the enormous expanses of cypress swamps in the Southeast, where production of *A. crucians* is extensive throughout, but where *A. quadrimaculatus* occurs only in trifling numbers. Controlling the latter by dusting or spraying the sunlit edges is effective with little cost. Further, dependable entomological surveillance permits restriction of control operations to areas where densities of potent vectors are sufficiently high to constitute a malaria hazard.

The program has achieved a fundamental partnership between the medical malariologist, the entomologist, and

Drainage Canal in Puerto Rico

the malaria control engineer. Malaria in humans is a disease. Responsibility for overall leadership lies with the medical profession. Medical malariologists determine endemicity, locate foci of infection, and study trends in the disease. Entomologists determine densities and breeding areas of vectors and check control results. Engineers, analyzing these data, apply the mechanics of sound engineering science to accomplish effective and economical control. Unless a balanced relationship is maintained between these three sciences, effectiveness or efficiency is sacrificed, or both.

Malaria Control in War Areas, as a program of preventive medicine, has achieved its purpose if judged from the remarkably low malaria rates among the armed forces in the United States. Figures recently released by the Army Medical Corps appear in Fig. 2. Data for 1943 exclude cases resulting from exposure overseas.

Two questions currently being debated by malariologists are: (1) Is it practicable to eradicate endemic foci of malaria from the continental United States, and (2) what protective measures should be instigated against exotic strains of malaria introduced by returning troops? Dr. L. L. Williams has proposed a solution to both questions through accomplishment of the first, on the principle that in the greater percentage of the malarious areas in the United States the disease is not perpetuating itself. Available morbidity and mortality statistics, blood-slide surveys, and other epidemiological findings substantiate this observation. Mortality rates for fifteen southeastern states have shown an uninterrupted decrease from over 4,000 malaria deaths in 1935 to about 800 in 1942. For the five-year period ending in 1938, 96 counties in 12 southern states reported average annual malaria death rates above 30 per 100,000. In marked contrast, for the five-year period ending 1942, there were only 14 such counties in seven states.

To balance the simple equation, human carriers plus anopheline vectors plus susceptible individuals equal malaria, the addition on the left of a third factor, "alpha" is required. This third factor represents a meticulously balanced relationship between vector, carriers, and ecological conditions under which the malaria parasite is perpetuated. Of these, the most important is the ecological setting fashioned by man or nature, or both. Of factors responsible for the recession of malaria to the present low ebb, conscious malaria control operations should be rated third or fourth in importance.

Screening, improved housing and environment, widespread household use of insecticidal sprays, and agricultural drainage have been major factors in transforming "alpha" in the malaria equation. When the balance is tipped sufficiently in the correct direction, malaria transmission becomes nil, even in the presence of susceptible individuals, human carriers, and mosquito vectors. If in the wrong direction, malaria is perpetuated and the area becomes an endemic focus.

Consider for a moment that an anopheline female mosquito lives about 18 days and has a blood meal approximately every three days, of which probably only one in twenty is from a human host. Development of the malaria parasite in the body of the mosquito requires about 11 days with optimum temperatures of from 71 to 86 F, depending on the species of *Plasmodium*. Assuming optimum conditions in an area having a constant gametocyte carrier rate of 2 per 1,000 population, simple mathematics shows that the chances that a given anopheline vector will become infective and transmit one case of malaria are 1 in 33,000.

Admittedly, there are several variables in this mathematical reasoning. For instance, very few female mosquitoes will live the assumed life span, probably not more than one in ten. This obviously decreases the chances of transmission to possibly 1 in 150,000. These hypothetical calculations illustrate how meticulously balanced must be the variable relations to produce malaria transmission. Further, they accentuate the soundness of the deduction that eradication requires an attack on the source—the permanent endemic foci.

PRACTICAL ELIMINATION IS POSSIBLE

The crux of the eradication proposal is to capitalize on the present set of biological conditions by erecting sufficient barriers in the few remaining endemic foci to tip the scales in favor of non-transmission. Malaria eradication is not predicated on vector elimination, it is simply shaping the form of "alpha" to serve the ends of man instead of malaria. The cardinal principles will include: (1) reduction in vector densities, (2) destruction of adult engorged female anophelines, and (3) segregation of vectors and human hosts by mosquito proofing.

In the first two methods, revolutionary procedures may result from a new insecticide now in full production. Evidence thus far indicates that unbelievably small quantities of this insecticide are effective against both larvae and adult mosquitoes. If large-scale impending field trials of this material substantiate claims now made, the resulting development may well be one of the outstanding salvage values of the war.

Leading malariologists feel that, under the present set of conditions, eradication of endemic foci of malaria from the continental United States is well within the probabilities. Scientifically the proposal appears logical and sound. With competent leadership, with full development of species sanitation, intelligent integration of basic control principles in water developments, a complete understanding with conservation interests, continuing research, and full use of educational media to stimulate community and individual effort, the job can be done. Financially it is within reason; an overall per annum expenditure of from five to ten million dollars (indexed to 1940) for three to five years might do the main job.

Practically there are many obstacles, not the least of which is the herculean task of marshaling federal, state, and local agencies in a concerted, well-coordinated effort. If such a program, or some well-conceived modification thereof, is pursued successfully, it is now believed that the impact of returning malaria carriers will, at worst, produce only isolated, self-limiting outbreaks.

Facts and Figures on Construction Trends

II. Economic Problems and Challenge for the Future

By Elsie Eaves, Assoc. M. Am. Soc. C.E.
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The fact that construction costs have not benefited as much from "technological improvement" as have costs in highly mechanized industries is a challenge to civil engineers. The highest seasonal and cyclical unemployment in any major industry is suffered by the construction industry. High wages, imperfect control over working conditions, non-repetitive operations that have to absorb high organization and dismantling costs—these are economic problems worthy of the best technical and professional attention if the postwar construction industry is to be both healthy and vigorous and is to help stabilize the national economy. Part I of this discussion, in the September issue, presented some of these economic problems of the past. Part II, which follows, shows methods that have been developed to solve them in part, and outlines the magnitude of future opportunities for civil engineers, whose professional skill can solve economic as well as professional problems.

THE engineering profession extends its talents to designing and building ever-improved and more efficient working facilities for other industries. An extreme example is the factory where temperature, humidity, and light can be regulated with precision to give workers maximum comfort and efficiency. While these structural and mechanical improvements give manufacturing added efficiency, the construction industry itself, with only minor exceptions, continues to work out in the open and to write its "acts of God" clause into all specifications.

Enclosures to make winter construction feasible were the first effort to achieve a measure of "controlled conditions" on construction. Night lighting has been improved but is still far below the standards enjoyed by manufacturing plants. More recently, covers to keep off the rain have been used by pioneering construction men. The Mud Mountain Dam tent, for example, helped maintain control of stabilized soil, and the Pit River Bridge paving was protected by a traveling cover that moved up with the construction gang. Since one of the construction industry's chief functions is to wrestle with "acts of God," undoubtedly future geniuses will develop ever more efficient ways of meeting these chronic problems.

American construction has thrived in a young, growing nation full of ambition for private and public improvements. It has designed and built great manufacturing plants that turn out products Americans want to own, products that compete more and more efficiently with construction itself for the American dollar. That these plants and the production methods used within them have caused manufacturing efficiency to increase faster than construction efficiency can be illustrated by simple examples.

Considering all modern industry of any size and importance, it is generally admitted that the one showing the least change in production technique prior to the war was private house construction. In 1939, it cost $5,767 to build a house that could have been built in 1914 for $3,833 (Fig. 1). These costs are for identical houses, with no changes in design. In 1938, on the other hand, a far better car could be bought for $783 than the quaint model which cost $1,115 in 1914. Thus there was a 50% increase in house costs compared with a 33% decrease in automobile costs. If the modern electric refrigerator were built by hand, on individual order, it would cost $1,500, but for $150 it has been possible to buy one of 2,000,000 built by mass or repetitive production methods.

Construction men seldom have the advantage of repetitive construction. Each structure they design and build is different in itself, or else its site presents different conditions from those met with on the last site. A construction structure has to be right the first time—there is no second chance to improve upon it. Exceptions include standard factory buildings, bridge standards developed by the states, and more recently, prefabricated houses.

This point is made here to illustrate the fact that by its basic nature, construction is less efficient than almost any form of repetitive production. Hence it imposes on both engineers and contractors a greater challenge to perfect their advance planning, since there is no opportunity to perfect a technique gradually on a series of identical jobs.

RELATIVE BUYING POWER OF CONSTRUCTION WORKERS

The high cost of building construction in general and home construction in particular is no minor problem. Value is often measured in dollars but the buying power of the dollar changes, so in considering house construction costs, we must compare them with mass production values in terms of the hours men must work to earn either a house or a new automobile (Fig. 2). In 1914 a skilled construction worker, earning $56^1/_2$ cents an hour, could earn a St. Louis house in 6,780 hours. In 1939, earning $1.41 per hour, it took him 4,090 hours. This is 60% of his 1914 effort, or a 40% gain for him. But he could earn an automobile in 1938 in 555 hours, or 28% of the hours required in 1914, a 72% gain in value.

Unskilled construction workers have gained more, proportionately, than skilled, from 17.7 cents an hour in 1914 to 67.8 cents in 1938. They could buy in 1938 a house with 39% of their 1914 effort, a gain of 61%. But it took only 18% of the 1914 effort to buy a better car, the gain thus exceeding 82%. The house is still the same house.

Small-house construction was the first class of construction to take a nose dive in the depression of the

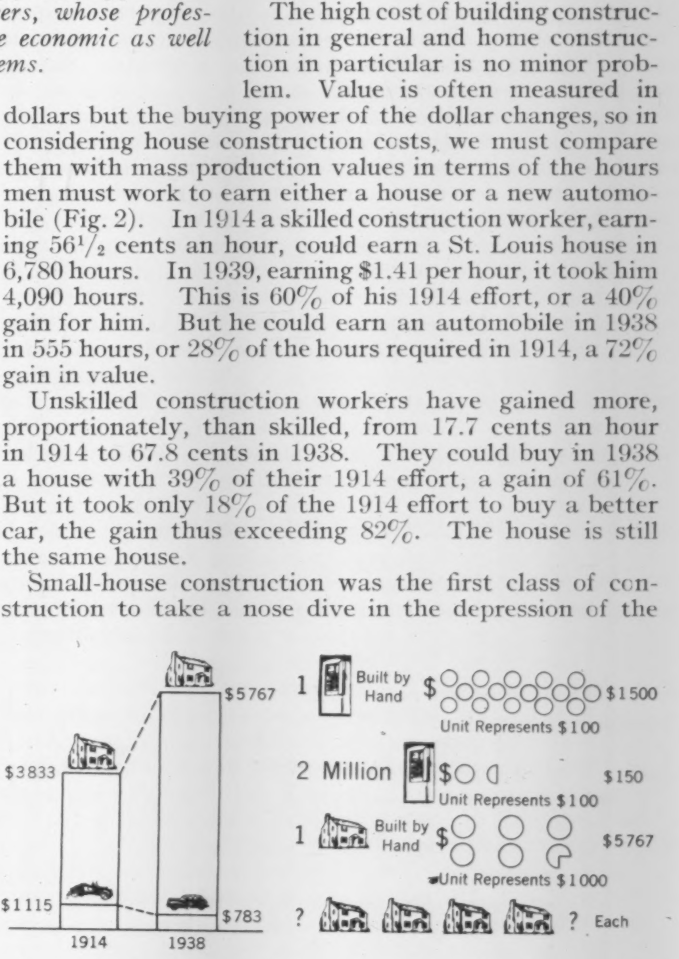

Fig. 1. Effect of Mass Production on Costs

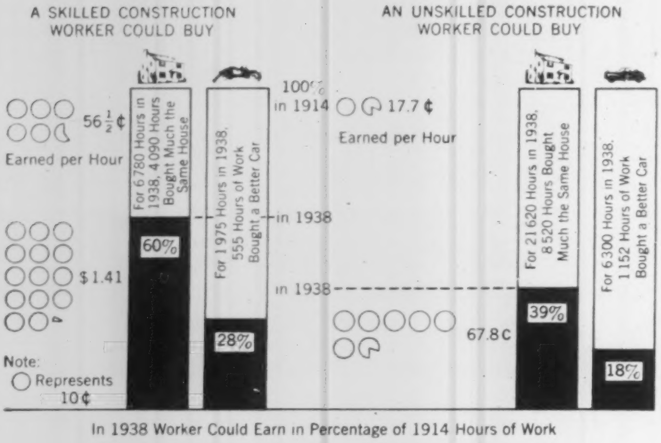

FIG. 2. WORKERS' BUYING POWER GREATER FOR MANUFACTURED PRODUCTS

thirties. It began its descent in 1929. It took the deepest dive and had the slowest recovery. It never came up to the hopes and expectations for it, in spite of FHA and other easy financing offers.

During the war the necessity for quantity production and speed introduced a number of engineering construction organizations to housing construction, and such factors as pre-cut and pre-assembled panels, assembly-line methods, and quantity consumption of glue, made their mark on house construction technique. New house designs are beginning to appear, with floors and roofs supported independently of interior partitions and exterior walls. Thus the structural engineer and the engineering construction contractor may play an important role in modernizing house design and developing mass production techniques which will improve housing's competitive position. The relatively low values and high costs heretofore prevailing have been due mainly to the predominance of hand-craft methods and limited mechanization in building construction.

The British in 1943 sent a commission of four men prominent in their building industry to study American construction methods. They reported (*Engineering News-Record*, November 11, 1943, p. 725) that: "For lack of labor-saving equipment, poorer advance planning and less repetitive work, building labor in England produces only $1^1/_2$ cu ft of new building per hour against $2^2/_3$ cu ft per hour here. Building costs, however, in both countries are about the same due to our much higher hourly pay rates in the United States."

MECHANIZATION REDUCES PRICES

After blaming high construction costs on hand-labor methods, let us see what construction men can do when they are given opportunities and machines for quantity production. In 1924 contractor's low bids submitted to the Iowa State Highway Department for pavement grading averaged 73 cents per cu yd; in 1939, 10 cents (see Fig. 3). In 1924 the men who drove the mules that pulled the scrapers earned from 40 to 55 cents an hour. In 1939 the men who operated the tractors and carryall scrapers earned from $1.00 to $1.50 an hour. Certainly the taxpayers of Iowa got more for their money in 1939. Construction workers obviously did too.

The *Engineering News-Record* construction cost index measures only the trends of construction wages for common labor and the prices of cement, steel, and lumber. It does not allow for labor efficiency, good management, competitive conditions, or other variables affecting construction costs. Unit prices bid by contractors presumably do reflect these variables. And prices bid on state highway work offer the nearest approach to comparable conditions on comparable work that the construction industry affords. Note on the chart, Fig. 3, how prices for common excavation, pavement concrete, and structural concrete went steadily down below material and labor costs, as mechanization of field construction methods improved. Note the rise in unit prices in 1935, when contractors were required to use more hand labor on federally financed work.

Construction was singled out of all industries in the depression period to revert by ukase to hand-craft methods. There is evidence to support the thesis (but not space here to argue about it) that the high costs due to construction's hand-labor methods in residential building helped precipitate the depression. Certainly residential building dropped sharply in 1929, before any other class of construction.

The Machinery and Allied Products Institute of Chicago has issued a study of the effect on employment of improved technology, with its resulting lower prices. This study offers the following food for thought, to quote:

"Further evidence of the effect of technology in creating employment is to be found in the fact that unemployment is more severe in the occupations in which little or no machinery is used and which have not had the benefit of technological development. One of the most severely depressed industries has been building construction, an industry which has experienced far less change in methods than manufacturing or other types of activity in which technology has played a more important role and in which production costs have continued high. Activity in building construction has made far less progress from depression lows than other industries more closely connected with technology. Since there is this lack of activity, employment is low.

"This activity has also caused employment to be low in the manufacturing industries dependent on building construction. . . . Throughout 1939 employment in these industries hovered around 50% of the Bureau of Labor Statistics 1923–25 average, while employment in the industries stimulated by technological advance was above the 1923–25 average.

"Similar evidence of high unemployment in hand trades is to be found in the United States Census of Partial Employment, Unemployment and Occupations, 1937, which showed that in the independent hand trades unemployment amounted to 26% of normal employment, whereas for all occupations there was 14% unemployment."

Thus reversion to hand-craft methods would seem to have compounded rather than cured construction's economic problems.

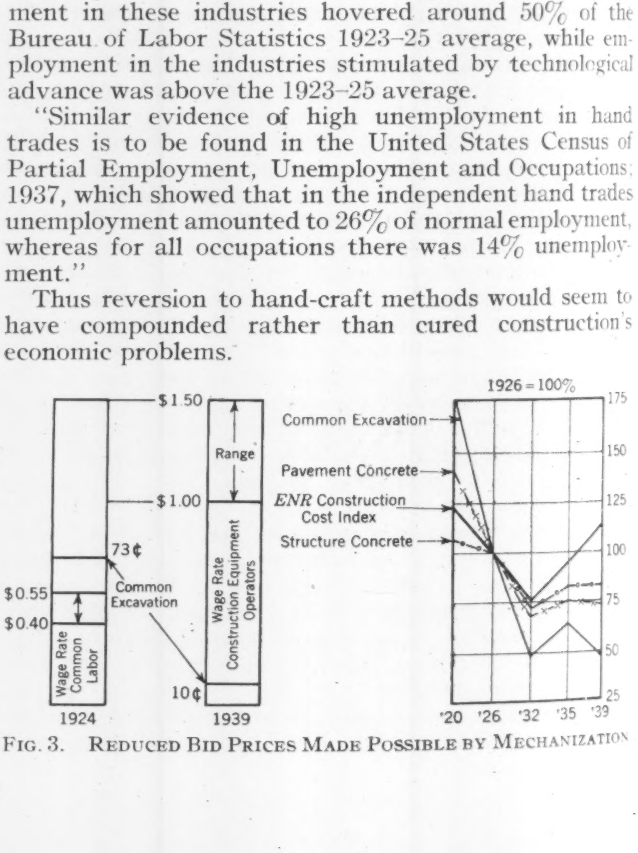

FIG. 3. REDUCED BID PRICES MADE POSSIBLE BY MECHANIZATION

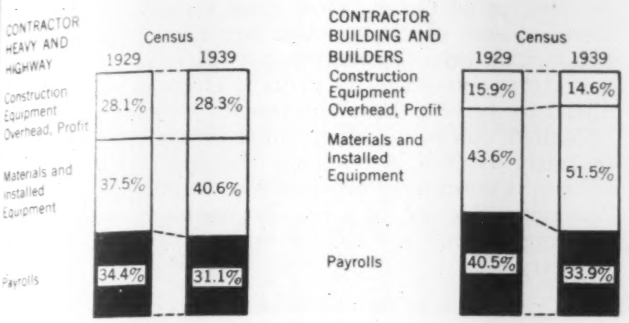

Fig. 4. Contractors' Payrolls Decreased as Factory Product Purchases Increased

Construction men tackle their problem of reducing costs in two ways:

1. Through better field methods, including advance planning and improved mechanization; and
2. Through buying more factory-produced, prefabricated or semifabricated products, products that have been standardized to get the benefits of mass production economies.

A sizable trend toward the second method is evident in the contractor census (Fig. 4), which shows that heavy and highway contractors spent about the same ratio, 28%, on construction equipment, overhead, and profit in 1939 as in 1929, but they increased their expenditures for materials and installed equipment from 37.5% in 1929 to 40.6% in 1939. They spent 34.4% on payrolls at the site in 1929, 31.1% in 1939. It is worth remarking here that construction wage rates for skilled labor rose 6% from 1929 to 1939; rates for common labor rose 25%; and prices of construction materials rose 1%.

This looks as though the failure of the construction employment curve, examined earlier in this discussion, to come back in proportion to the recovery in construction volume is due in part at least to the increased use construction men are making of factory labor in place of field construction labor.

Reports of contractors in the building field, where improvement in construction costs was most needed, show an even more pronounced trend toward smaller field construction payrolls. In 1929, 40.5% of the building contractor's dollar went for payrolls at the site, 33.9% in 1939. Materials and installed equipment got 43.6% of his 1929 dollar, 51.5% of his 1939 dollar.

The engineers who make the plans and write the specifications which the construction industry must follow, wield billions of dollars worth of buying power. They determine whether construction field labor or factory labor will be employed. Their technical decisions as to the use of standard units or "specials" affect both manufacturing and construction costs and organizations.

Industries most dependent on this buying power of construction engineers and contractors were analyzed in studies made by the Bureau of Labor Statistics, of PWA projects in 1937. Results are shown in Fig. 5. For example, on overpasses and underpasses, 41.8 cents out of each construction dollar went for materials and equipment; 3.8 cents for forest products; 13.4 cents for stone, cement, clay or glass; 17.1 cents for iron and steel; 2 cents for machinery.

Forest products received from the mass housing dollar 4.4 cents, from the post office dollar 8.7 cents. Iron and steel got 10.4 cents from mass housing, 11.3 cents from post offices. Stone, cement, clay, and glass got 14.3 cents from the housing dollar, 18 cents from the post office dollar; heating and ventilating, 4.5 and 4 cents, respectively. Plumbing got 5.9 and 4.4 cents, respectively, from housing and from post offices; and electric wiring and fixtures got 2.7 cents from each. The chemical industries, non-ferrous metals, and other miscellaneous industries contributed in smaller ratio to the construction whole.

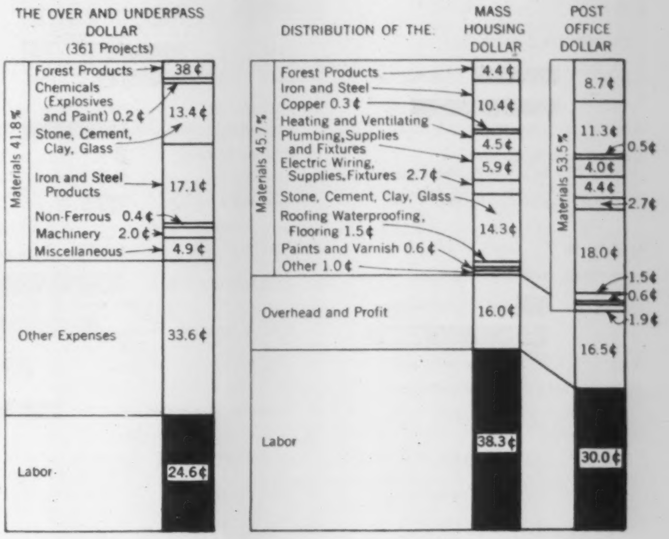

Fig. 5. Principal Industries Supplying Construction (PWA Studies, 1937)

Industries that watch the structural industry's buying power and buying habits with keen interest include the metals, cement, concrete aggregates, and lumber. Before the war, construction consumed from 25% to 35% of the steel then produced (Fig. 6). In 1939 steel's production capacity was 50 million tons. In 1943 it had increased to 90 million tons. What engineers put in their plans and specifications will have a major effect on how much of this capacity is used after the war.

Before the war, construction men were trying out many special applications of aluminum, and eying its possibilities. In 1939 the aluminum industry produced 440 million pounds (including secondary production from scrap). Aluminum was priced at 20 cents a pound. In 1943 aluminum capacity had soared to 2,846,000,000 lb, expanded almost 7 times, and the price had declined to 15 cents, a 25% drop. The construction industry will undoubtedly have a major influence on how much of this capacity will find postwar use.

Compared with the metals, cement has been relatively unaffected by the war. Shipments rose with construction volume to 185,000,000 bbl in 1942, but cement did not increase its production capacity owing to war conditions. In 1939, 62% of the cement shipped went into heavy engineering construction, 6% into concrete products, 6% into homes, and 26% into rural and small uses.

In 1939 the crushed stone, sand, gravel, and slag industries depended on the construction industry to use 82% of their production. This is an interesting group of materials because it is the outstanding example of materials still produced by construction men at the site. In 1939, 29% of all the aggregate used was produced by the construction industry itself, and 53% was bought by the construction industry from commercial producers.

In 1941 civilian and military construction bought 74% of the nation's lumber, woodworking factories took 11%, boxing and crating 15%. In 1944 construction is allotted 41%, wood-working factories 12%, and boxing

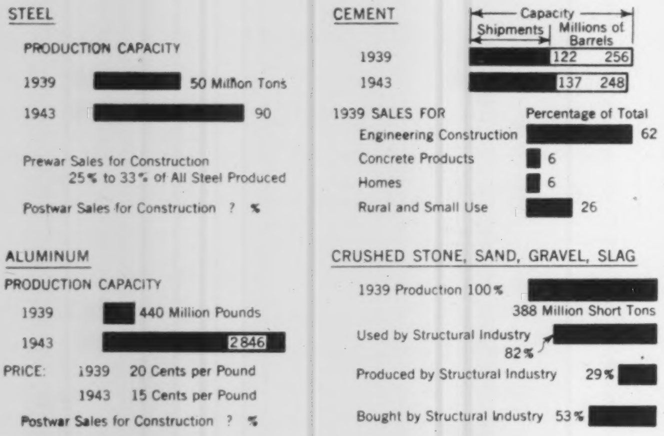

FIG. 6. INDUSTRIES PRIMARILY INTERESTED IN CONSTRUCTION BUYING POWER

and crating 47%. Postwar construction plans and specifications thus will have a major effect on postwar readjustments in the lumber industry, when expanded war requirements for crating and boxing return to normal.

Early in this discussion it was pointed out that civil engineers are the first to feel new economic trends. They serve efficiently as economic weather vanes. All through this discussion turning-point years have been used to illustrate how economic changes affect civil engineers, and through them the great construction industry they help to set in motion.

Through the far-sighted efforts of engineers, architects, contractors, public officials, and business men, many engineers and architects are now at work preparing the plans and specifications that will make projects ready to go under construction as soon as men and materials are released again for civilian use. The Committee on Postwar Construction of the American Society of Civil Engineers has set as its objective the goal of $15,000,000,000 by July 1, 1945, in construction projects for which plans are completed, ready to take bids.

Specific engineering construction projects proposed for postwar construction, and reported to *Engineering News-Record* through June 1944, totaled over $11,000,000,000. This is made up entirely of identified specific projects—no general programs are included in this figure. Engineers and architects were at work on, or had completed, plans for projects totaling $3,250,000,000.

The chart, Fig. 7, shows how this reservoir of proposed and planned projects fits into the engineering construction budgets. Sewerage, water works, bridge and highway projects proposed exceed one year's maximum budget; proposed earthwork and waterways projects top nine years' maximum budget. Unclassified and building projects are below their budgets. Both these latter classes of construction are normally heavily dependent on private investment, which has been reticent to date to announce its plans. There is still a big job ahead to convert these "proposed" projects and more to "planned" projects, which must be done before we can be fairly assured of reaching the $15,000,000,000 goal of the Committee on Postwar Construction of the American Society of Civil Engineers, and in turn of meeting the postwar volume budgets of the construction industry.

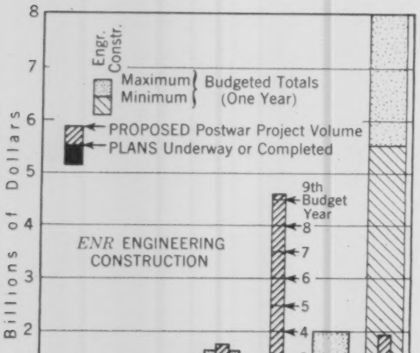

FIG. 7. ESTIMATES OF POSTWAR CONSTRUCTION BUDGETS

VOLUME OF POSTWAR CONSTRUCTION

Now a new turning-point year is in the making, the year that marks the transition from war to peace. And again construction engineers are in the vanguard, working out plans for postwar projects. What is expected of the construction industry in the postwar reconstruction can be readily seen from the construction budgets that are proposed by the most eminent authorities (Fig. 7). These include the following:

AUTHORITY	ANNUAL BUDGET Total Construction All Classes
W. C. Bober, Economist of Johns-Manville	26 billion
S. Morris Livingston, Chief, National Economics Unit, U.S. Dept. of Commerce (assumes National Income at $165,000,000,000 in 1946)	17.7 billion
Willard T. Chevalier, M. Am. Soc. C.E., Publisher, *Business Week*, also the Producers Council Inc.	16 billion
Maj. Gen. Philip B. Fleming, M. Am. Soc. C.E., Federal Works Administrator	15 billion
Francis W. Herring, M. Am. Soc. C.E., former Assistant Director, National Resources Planning Board	14 billion
Engineering News-Record and *Construction Methods*	12 to 18.7 billion

Compared with prewar standards, highly colored by depression years, these budgets look slightly staggering. Actually they are conservative when measured against a national income of 150 billion dollars, which is what economists say will result from full employment of our productive workers, the No. 1 postwar objective. The highest of these budgets is 17% of this assumed national income. Both in 1925 and in 1927, construction and maintenance topped 17% of the national income. The other budgets are 12%, 11%, 10%, 9%, and 8% of an assumed $150,000,000,000 national income.

One of the backlogs of demand supporting these budgets is that for housing. A Department of Commerce survey reports that 1,540,000 families intend to build or buy a new home within six months after the war is over. Of these, 23% will spend $3,000 or less, 27% between $3,001 and $5,000. This anticipated residential building investment totals $7,184,800,000. Out of total postwar construction, heavy engineering construction, including mass housing, is budgeted for from $8,700,000,000 to $13,100,000,000 annually.

Every new set of political and economic conditions is a challenge to the construction industry. Certainly the postwar period offers this great industry its greatest challenge and its greatest opportunity—the challenge to improve its own economic efficiency and competitive position in relation to other efficient industries, the opportunity to resume its primary function of improving American standards of living and working, and the opportunity to help other peoples to raise theirs.

Engineers and architects who make the construction industry's plans and write its specifications, and engineers and contractors who translate these plans and specifications into three dimensions, will have the responsibility of spending from 8% to 17% of our national postwar income. They will in large measure set the pattern for our postwar way of life.

Engineers' Notebook

Suggestions and Practical Data Useful in the Solution of a Variety of Engineering Problems

Velocity-Head Rod Calibrated for Measuring Stream Flow

By H. G. WILM, SENIOR SILVICULTURIST, ROCKY MOUNTAIN FOREST AND RANGE EXPERIMENT STATION, FORT COLLINS, COLO.

and H. C. STOREY, FORMERLY ASSOCIATE GEOLOGIST, CALIFORNIA FOREST AND RANGE EXPERIMENT STATION, BERKELEY, CALIF.

A DEPENDABLE yet cheap and rugged measuring stick was developed several years ago at the San Dimas Experimental Forest, in Southern California, to facilitate the calculation of discharges from mountain streams. This device, which has been described in technical publications, is particularly useful in gaging small volumes of flow containing varying amounts of bed-load and silt. Measurement of these flows is made continuously by weirs or measuring flumes, the calibration of which should occasionally be checked in place. The instrument (Fig. 1) is simple, portable, easy to construct and accurate within practical requirements. Its principle is not new, being simply an application of Bernoulli's theorem somewhat different from that employed in the Pitot tube.

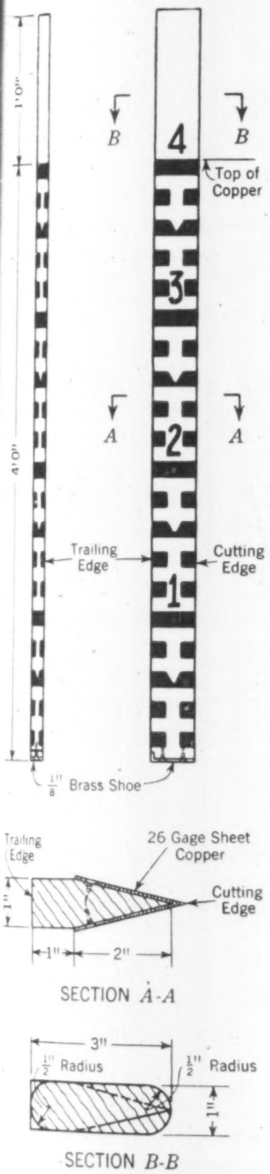

FIG. 1. VELOCITY-HEAD ROD DEVELOPED AT SAN DIMAS EXPERIMENTAL FOREST

In use, the rod is first placed in the water with its foot on the bottom and the sharp edge facing directly upstream. The stream depth at this point is indicated by the water elevation at the sharp edge, neglecting the slight ripple, or "bow wave." If the rod is now revolved 180 deg, so as to oppose the flat edge to the stream, a hydraulic jump will be formed by the obstruction to the flow of the stream. The average height of this jump measures the total energy content of the stream at this point; the jump height, minus the depth, equals the actual velocity head. Velocity can then be computed by the standard formula,

$$V = \sqrt{2gh} = 8.02\sqrt{h} \quad (1)$$

in which V = velocity, in ft per sec

g = acceleration of gravity (taken as 32.16 ft per sec per sec)

h = velocity head, in ft

The average discharge for the stream is obtained by taking a number of measurements of depth and velocity throughout its cross section.

TABLE I. CALIBRATION OF VELOCITY-HEAD ROD—DISCHARGES IN CU FT PER SEC

AVE. DEPTH, FT	DISCHARGE	CHECK DISCHARGE	DEVIATION, %
* 0.232	3.95	4.25	−7.1
0.444	8.89	8.70	+2.2
0.625	13.52	13.24	+2.1
0.792	17.23	17.04	+1.1
0.925	23.33	23.42	−0.3
0.955	23.39	22.29	+2.0
1.227	33.06	33.15	−2.7
1.358	37.59	36.20	+3.8
1.700	48.76	48.45	+0.6
†0.060	0.214	0.215	−0.5
‡0.077	0.185	0.190	−2.6
§ 0.338	2.98	2.93	+1.7
0.338	2.89	2.93	−1.4
0.370	3.43	3.48	−1.4

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* Measurements taken in 4-ft San Dimas flume, checked by a 16-ft suppressed weir at a flume laboratory on the San Dimas Experimental Forest.

† Measurements taken with push-rule used as a velocity-head rod in 2-ft Parshall flume, checked by 3-in. Parshall flume.

‡ Measurements taken with push-rule used as a velocity-head rod in 10-ft Parshall flume, partly blocked by sand bar; $W = 3.2$ ft; area = 0.246 sq ft. Checked by 90-deg V-notch; $Q = 2.49H^{2.48}$.

§ Readings taken with rod in 2-ft San Dimas flume, checked against 90-deg V-notch weir ($Q = 2.49H^{2.48}$). The first two groups of readings were taken by different observers, on the same discharge.

In tranquil flow, the jump on the rod is very steady and can be read easily; in turbulent flow, on the other hand, it often fluctuates as much as 0.1 ft or even more. This fluctuation may be explained by the fact that the column of water impacting on the rod has constantly varying contents of kinetic energy. At one instant, filaments of water may converge upon the rod; at another they may diverge. As indicated by Eq. 1, however, errors in reading give errors in percentage of discharge equal only to one-half the percentage reading error.

TABLE II. COMPARISON OF SPECIFIC ENERGY MEASURED AT PIEZOMETER OF 16-FT SUPPRESSED WEIR WITH ENERGY MEASURED BY VELOCITY-HEAD ROD ON WEIR CREST

H ABOVE LEVEL OF WEIR CREST, FT	PIEZOMETER $H + V^2/2g$, FT	ROD $H + V^2/2g$, FT	DEVIATION, %
0.168	0.168	0.165	−1.8
0.454	0.456	0.46	+0.9
0.542	0.546	0.55	+0.7
0.564	0.568	0.56	−1.4
0.708	0.716	0.73	+2.0
0.750	0.759	0.77	+1.4
0.910	0.925	0.94	+1.6
0.918	0.933	0.94	+0.7
1.117	1.141	1.13	−1.0
1.210	1.240	1.25	+0.8
1.297	1.332	1.32	−0.9
1.415	1.459	1.45	−0.6
1.489	1.538	1.52	−1.2

To test the relative accuracy of this rod in estimating open-channel discharges, the authors have taken quantitative observations under a variety of conditions. Some of the data in Table I, for example, were obtained in a 4-ft San Dimas flume and compared with discharges measured over a 16-ft suppressed, sharp-edged weir (see explanatory footnotes). Other discharges presented in this table were measured with the rod in 2-ft and 10-ft Parshall flumes, and checked against data obtained in a 3-in. Parshall flume and a 90-deg V-notch weir.

In Table II, the actual specific energies (depth plus velocity-head) of discharges over the 16-ft suppressed weir are compared with specific energies measured with the velocity-head rod on the weir crest. And finally, Table III presents velocity-head rod data obtained to check the laboratory calibration of a 2-ft San Dimas flume in a field installation. For low discharge rates, the flume had already shown satisfactory correspondence with a V-notch weir; the rod data agree within practical limits of error for higher rates of flow.

The rod has obvious limitations: it is inaccurate for velocities much below 1 ft per sec, and for streams with soft, unstable beds, and it cannot be handled well in streams moving faster than 8 or 9 ft per sec. It has, however, a very definite and considerable value as the only method usable within this range, where the streams to be measured contain debris and bed-load.

Table III. Check Calibration of 2-Ft San Dimas Flum Installed at Gaging Station VII, San Dimas Experimental Forest*

Head in Flume, Ft	Ave. Velocity (Flume), Ft per Sec	Q by Formula, Cu Ft per Sec	Q by Check, Cu Ft per Sec	Deviation %	Remarks
0.216	4.39	1.85	1.89	−2.1	Little bed-loa
0.288	4.53	2.69	2.63	+2.3	Little bed-loa
0.416	5.11	4.27	4.20	+1.6	Bed-load
0.530	5.90	5.83	6.25	−6.7	Heavy load
0.562	5.54	6.26	6.22	+0.6	Bed-load
0.562	....	6.26	6.56†	−4.6	Bed-load
1.58	8.19	23.39	25.88	−9.6	Flume over topping, heavy bed load
0.348	4.63	3.39	3.42	−0.9	Flow clear
0.309	4.41	2.91	2.98	−2.4	Flow clear
0.309	4.28	2.91	2.89	+0.7	Flow clear

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* Computed flows for the 2-ft San Dimas flume were obtained by the formula, $Q = 13.05H^{1.277}$, which is derived from a general formula based on 1, and 3-ft San Dimas flumes.

† Velocity-head rod data taken in 10-ft Parshall flume operated in tandem with 2-ft San Dimas flume.

The Two Moment-Area Theorems—A New and Shorter Method of Proof

By Donald Bregman

Design and Construction Division, Department of Water and Power, Los Angeles, Calif.

A shorter and more clarifying proof of each of the two well-known moment-area theorems can be provided if the properties of elementary lengths of the beam under consideration are examined. Restated, the first moment-area theorem is: "The angle between the tangents at any two points on a beam is equal to the area of the M/EI diagram between the points." Proof is indicated by examination of Fig. 1. Let

AB = any length of a beam subject to any moment
θ = angle corresponding to arc AB
$\Delta\theta$ = angle corresponding to the elementary arc Δs
Δx = horizontal projection of Δs
M, E, I = respective moment, modulus of elasticity, and moment of inertia of the beam at any point

Also, let the shaded portion in the lower figure be the part of the M/EI diagram corresponding to length AB of the beam (the values of M/EI having been plotted with respect to the horizontal axis XX, as shown).

Referring to Fig. 1, $\Delta\theta = \Delta s/R$, and since $\Delta s = \Delta x$ for all practical purposes, then

$$\Delta\theta = \frac{\Delta x}{R} \quad \text{(1)}$$

Substituting for $1/R = M/EI$, Eq. 1 becomes

$$\Delta\theta = \frac{M\,\Delta x}{EI} \quad \text{(2)}$$

In this expression, the right-hand side is the elementary area of the M/EI diagram corresponding to the elementary beam length Δs. Hence, for angle $\theta = \Sigma\,\Delta\theta$, by summation,

$$\theta = \sum \frac{M\,\Delta x}{EI} \quad \text{(3)}$$

It is to be noted that when E and I are constant, Eq. 3 may be written $\frac{1}{EI}\,\Sigma M\,\Delta x$, in which $\Sigma M\,\Delta x$ is the area of the part of the moment diagram corresponding to the length AB of the beam.

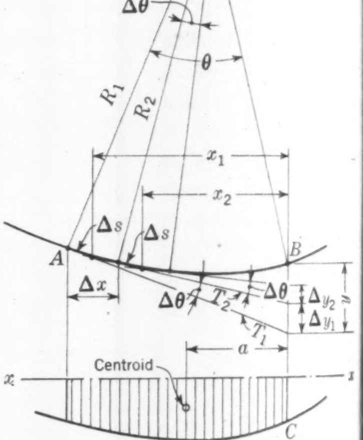


Fig. 1. Segment of Beam Under Stress, with Corresponding Moment-Area Diagram

The second moment-area theorem can be restated: "The deflection at any point of a beam, measured from the tangent of any other point, is equal to the moment about the first point of the area of the M/EI diagram between the two points." Proof of this theorem can also be simplified. Let the notation in this case be the same as in Case 1, and in addition, let x_1, x_2, x_3 . . . , Δy_1, Δy_2, Δy_3 . . . y, and T_1 and T_2 be as shown. Also, in the lower figure, let a be the distance from the centroid of the shaded portion (of the M/EI diagram) to the line BC, as shown.

Then, referring to the figure, $\Delta y_1 = T_1\,\Delta\theta$. For all practical purposes, as reasoned for $\Delta s = \Delta x$,

$$\Delta y_1 = x_1\,\Delta\theta \quad \text{(4)}$$

Substituting for $\Delta\theta = M\,\Delta x/EI$ (from Eq. 2),

$$\Delta y_1 = \frac{x_1 M\,\Delta x}{EI} \quad \text{(5)}$$

It is to be noted that the right-hand side of Eq. 5 is the expression for the statical moment of an elementary area of the M/EI diagram corresponding to the elementary beam length Δs, distant x_1 from point B. But

$$x_1 \frac{M\Delta x}{EI} + x_2 \frac{M\Delta x}{EI} + x_3 \frac{M\Delta x}{EI} \ldots = a \sum \frac{M\Delta x}{EI} \ldots (6)$$

Hence,

$$y = \Delta y_1 + \Delta y_2 + \Delta y_3 \ldots\ldots = a \sum \frac{M\Delta x}{EI} \ldots (7)$$

As in Case 1, it should be noted that when E and I are constant, $1/EI$ may be placed outside the Σ sign, thus reducing Eq. 7 to

$$y = \frac{a}{EI} \sum M\Delta x \ldots\ldots\ldots\ldots\ldots (8)$$

Our Readers Say—

In Comment on Papers, Society Affairs, and Related Professional Interests

Recollections About Peru

TO THE EDITOR: General Schley's article, "Ocean-to-Amazon Highway," which appeared in the October issue of CIVIL ENGINEERING, was very interesting to me because it brought to mind the years I spent in Peru. From 1904 to 1909 I was located in Peru, where I was in full charge of the Cerro de Pasco Railway, a standard gage line of 110 miles, constructed for the Cerro de Pasco Mining Company along the high plateau region just east of the main cordillera.

After various easterly trips of investigation I became convinced that the land drained by the head waters of the Amazon was susceptible of sustaining a large population. However, at that time, there was only a very small population in this region, except for the uncivilized Indians of the interior. And for all I know, this is still the case.

In 1906, highways were not seriously considered, and my report set forth the possibilities of a railway line from the Corhuamayo station of the Cerro de Pasco to navigable water on the Pachitea River. This terminal was afterwards changed to a location on the Ucayali River, a short distance below the confluence of the Pachitea with the Ucayali, making a total length for the suggested railway of 250 miles. This was an entirely feasible proposal both as to construction cost and gradients.

The highway completed this year by the Peruvian government parallels the railways from the Pacific at Callao to Cerro de Pasco, thence via Huanico and Tingo Maria to the Ucayali River, which it reaches at practically the same terminal suggested for the proposed railway. The highway which is on a route north of the suggested railway line, is now in operation, and these developments will doubtless affect this wonderful region. There is room for a large population, and it seems to me that serious consideration should be given to the possibility of establishing homes there for European war refugees in this great undeveloped region, which is blessed with a salubrious climate and very fertile land. There is possibly no other tract on the face of the globe that offers the possibilities of this part of South America.

The highway work was done in collaboration with United States technical officials. Perhaps my reports to the Cerro de Pasco Mining Company were available, as I recognize items of similarity—particularly the mention of the possibility of a westerly outlet to the Pacific. This problem was a study of the possibilities of an outlet to the Pacific as compared to the easterly route to the Ucayali River. From the summit of the cordillera no pass lower than 16,000 ft was available. The air line distance to the coast from the summit is about 70 miles.

The topography on the road to the Pacific fitted in nicely for a series of straight gravity planes connected by relatively short independent railway lines. Electric power was abundant to augment operation. The report relative to the recently completed highway in Peru also mentioned the possibility of hauling ores from the upper region, where large tonnages are available, to the coast, and the suggestion was made that gravity planes could be considered.

I have frequently been asked why the development of eastern Peru has been so slow. The better class Peruvians have never been successful colonizers, and have been quite contented to reside on the western coast in the productive valleys there. In the Sierra region, the country of high elevations, the inhabitants are Quitchua Indians, descendents of forebears who were subject to Inca rule. Not given to migrating, these Indians are averse to seeking trouble with the warlike Indians of the interior, who are of a different race. The Sierra Indians were thoroughly regimented when ruled by the Incas. They have never outgrown the Inca system, and living in the same villages and following the same customs required by the Inca regulations are still in vogue.

H. S. KERR, M. Am. Soc. C.E.

Salt Lake City, Utah

Comments on Design of Plywood Panels

DEAR SIR: In his article on "Design of Built-Up Plywood Panels," in the September issue, Mr. Scott illustrates the use of a very interesting design method proposed by John A. Newlin, M. Am. Soc. C.E. (Forest Products Laboratory Bulletin No. R1220, March 1940). In this method use is made of the idea of the effective (or basic) width of thin sheets in compression. This concept, originated by Prof. Theodor von Karman in 1932, is widely used in airplane design and related fields.

The writer is somewhat at a loss, however, in understanding the use of this concept in Mr. Scott's numerical example. The effective width is determined for a sheet in compression, from considerations of buckling exclusively, as explicitly stated by both Mr. Scott and Mr. Newlin. A sheet in tension has no tendency to buckle, of course, and therefore its full width is to be regarded as effective. In Mr. Scott's example, however, the actual 16-in. width of the bottom (tension) sheet is reduced to the basic, effective width of $13^5/_8$ in., although the latter is determined from buckling considerations—that is, for compression. In the example, the 5-ply top compression sheet is thick enough not to require any reduction in design width, whereas the 3-ply bottom sheet, being in tension, does not require a reduction regardless of thickness. Mr. Scott's computations of the location of the neutral axis and the moment of inertia would be correct if the 3-ply sheet were on top, or in compression, and the 5-ply sheet on the bottom, or in tension. As shown in his Fig. 1, neither the top nor the bottom sheet needs any reduction in design width.

It is unfortunate that Mr. Newlin's pamphlet does not contain information on whether his formulas were checked by tests or whether they were derived analytically from Professor von Karman's concept. (For a brief account of the latter, see Timoshenko, *Theory of Elastic Stability*, pp. 395–397.) Mr. Newlin states that his formulas for the basic width (Eqs. 1 and 2 in Mr. Scott's article) were based on an "edge fixity factor" of 2.13, as compared with von Karman's original factor of 1.9 for free edge support. Tests by Sechler on metal sheets (Timoshenko, *ibid*, p. 402) show that this coefficient varies from about 1.9 for extremely wide and thin sheets to about 1.1 for sheets of smaller width-thickness ratio. Extensive tests on steel sheets with restrained edges by the writer showed that Sechler's coefficients should be used not only for free edge conditions, but also for partially restrained edges. In aircraft design, for partially restrained edges, either a coefficient of 1.7 (instead of von Karman's 1.9 or Newlin's 2.13) is used or a variable coefficient, according to Sechler's graph, is considered. The latter is considerably smaller than 1.9 for all width-thickness ratios possible in plywood construction (see A. S. Niles and J. S. Newell, *Airplane Structures*, vol. 1, pp. 291 and 329).

Unless, therefore, Mr. Newlin's coefficient of 2.13 is based on direct empirical evidence, it would seem that, in the interest of safety, it should be lowered at least to 1.7. This would mean that the "basic widths," given by Mr. Scott's Eqs. 1 and 2, should be decreased at least in the ratio 1.7: 2.13, that is, by about 25%. Consequently, in Eq. 1 the value of 31 should probably be changed to about 25, and in Eq. 2 the value of 36 should be decreased to about 29.

GEORGE WINTER, M. Am. Soc. C.E.
Assistant Professor of Civil Engineering
Cornell University

Ithaca, N.Y.

Engineers in the Normandy Invasion

DEAR SIR: On page 451 of the October number of CIVIL ENGINEERING, there is an extract from some remarks by a popular broadcaster on the work of engineers in the Normandy invasion. It is always satisfactory to have the work of engineers properly publicized, although they do not now suffer from lack of recognition of their exploits, as was the case up to the time of Richard Harding Davis, the first writer in this country to attempt to make a popular hero of an engineer. Much of the article quoted is reasonably correct and all of it is interesting, but it is a surprise to find that there has been passed for publication in a technical periodical some of the statements about maps and mapping. I refer to the statement that, "No maps had been made of northwestern Europe suitable for military operations since the days of Napoleon."

Apparently we are supposed to believe that the war with Germany from 1914 to 1918 was fought without the use of maps on either side. Apparently also the Germans invaded and conquered France without maps suitable for military operations. Farther in the same article it is stated, "They made maps of such accuracy as to distance and elevation that unobserved artillery fire could be carried out effectively by night as well as by day, something unknown till this war." It would seem to have been the belief of whoever is responsible for these statements that military mapping had been entirely neglected in Europe until the arrival of American engineers in 1942 and that, in the ensuing two years, they were required to make complete topographical maps of all northwestern Europe, which was unmapped territory before they entered the country.

I have a collection of maps salvaged at our G.H.Q. before I returned to this country in 1919 after service in the first World War. Some were reproduced by our Army Map Service, and all were based on surveys made in France and Germany throughout the nineteenth century and later.

I can recall hearing in my camp, from a distance of twenty miles away, the noise of the artillery firing from the French lines around Verdun at night, although according to our writer that must have been impossible in those ancient days. It is not surprising to find such statements as those I have quoted made by a broadcaster who has to say something spectacular in a brief time, or even in a newspaper or magazine article, but it seems hardly proper that publicity should be given to such misinformation in a scientific publication.

HENRY WELLES DURHAM, M. Am. Soc. C.E.

New York, N.Y.

The Late J. F. Stevens—Born Raconteur

TO THE EDITOR: I once had the good luck to be official aide for a week to the late John F. Stevens, Past-President and Honorary Member of the Society. After Mr. Stevens retired he used to like to slip into the Canal Zone unannounced for a look at his old job. It was on his second such trip that I was with him and heard some of his inimitable stories—he was a born raconteur. In Mr. Stevens' 92 years he easily lived a century and a half of experience. His work took him to Manchuria, Spain, Mexico, Panama, an other countries, and members of the Society may be interested i the following typical story sequence.

"Four years after I left the Canal Zone I made an investigatio and plans for the rehabilitation of Spain's railroad system. The had a premier just then who had far-reaching hopes and ambition for modernizing his country. On arrival, I had to waste time o some diplomatic folderol. In my audience with King Alfonso XII I assumed we were to discuss Spain's transportation system Not at all! Do you know the one question he put to me was 'What was the price of pork in Chicago when you left America? It actually was; it seems he often speculated on our Stock Exchanges—made money at it, too.

"Did Spain fix up her railroads as per our plans? Not at all Shortly they assassinated the progressive premier, and things ther have been getting worse and worse, I hear.

"I hate bull fighting; it makes me sick to see good horse fles mangled and useless bloodshed—always did in Mexico. But, had to attend a bull fight in Madrid, so I watched the people an especially the Royal Box instead of the arena. I was puzzled a seeing Queen Ena (Victoria Eugenie), reared in England and granddaughter of Queen Victoria, with opera glass pointed unceasingly at the action in the arena. With her background how coul she, I wondered. Later I was confidentially told she'd sickened a her first fight and went no more—until the populace demurre loudly. Then the king had had a special short-focused lens inserted in her glasses. So the poor Queen had been simply acting she couldn't actually see over six feet if she kept the glass up t her eyes. What a life!

"Finally it came time to go home, and I reserved transportatio for my force from Southampton. We were to leave early in Apri 1912 on a grand new liner that was making her maiden voyage But the boys weren't interested in leaving so soon; we'd been s busy they'd had no time to see something of Spanish life. So had the transportation switched to the next boat—and that's why we weren't on the *S.S. Titanic* when she hit the iceberg!"

RALPH Z. KIRKPATRIC

Rochester, N.Y.

Forum on Professional Relations

CONDUCTED COLUMN OF HYPOTHETICAL QUESTIONS WITH ANSWERS BY DR. MEAD

Herewith Dr. Mead gives his answer to Question No. 26, whic was announced in the September number of "Civil Engineering." The question states: "An engineer employed by a power company upon examining the plant of a subscriber, becomes aware that th subscriber can save money by making certain changes in certai apparatus in use. Should he inform the subscriber or the powe company for which he is working of this fact?"

The engineer employed by the power company owes his allegianc to his employer and should, therefore, first advise the power company of the fact that he finds the subscriber may save money b making certain changes in certain apparatus in use. If it is foun that the saving would warrant the expense involved, the powe company should certainly advise the subscribers to that effec and recommend the changes suggested.

On the other hand, the engineer employed by the power compan may be an expert and fully authorized to discuss with the subscriber such difficulties as he may find and advise the subscribe how best to overcome the trouble.

DANIEL W. MEAD, Past-President an
Hon. M. Am. Soc. C.E.

Madison, Wis.

Question No. 27, which was announced in the October issue, wil be answered in the forthcoming, or December, number. Next i the series the following question is announced. Replies may b received until December 5, with answers in the January issue.

QUESTION NO. 28: *Bids for some paving were received by the cit council in a small city. Among these was a bid from a contracto who was a personal friend of many of the aldermen. The contractor' bid was as low as any other presented. Is the council warranted i awarding the work to this contractor, if it is satisfied with his experience along the line in question?*

SOCIETY AFFAIRS

Official and Semi-Official

Five Engineer Presidents Propose Insurance Against Another War with Germany

Fully realizing the contributions which the German nation—if freed from the control of international gangsters—can make to a postwar world, a constructive proposal for the treatment of a defeated Germany has been made by the presidents of five national engineering societies.

This statement, which was signed September 29, 1944, challenges any plan to destroy indiscriminately all productive capacity of Germany following our victory. Such plans of destruction, already turned into good propaganda by the Goebbels machine, have been circulated widely. It is the hope of the eminent engineers who have composed the following modified program, that a more rational approach to the problem may secure support. Toward this end the statement is being distributed to many publications and has been sent with the letter reproduced here to the Secretary of State.

LETTER ADDRESSED TO THE SECRETARY OF STATE

October 2, 1944

From the Presidents of:
American Society of Civil Engineers
American Institute of Mining and Metallurgical Engineers, Inc.
The American Society of Mechanical Engineers
American Institute of Electrical Engineers
American Institute of Chemical Engineers

To the Secretary of State
Washington, D.C.

Dear Mr. Secretary:

Recognizing the technical and industrial problems involved in the permanent disarmament of Germany, the presidents of the above-listed engineering societies initiated discussions on this subject in March 1944 with many members of the profession. Since that time we have continued the studies of this problem.

We are enclosing herewith the first draft of a paper dealing with this subject. We realize fully that the procedures suggested from an engineering viewpoint have not been fully considered with and coordinated with the international-political problems involved. We believe that the proper integration of the political with the engineering aspects of the whole problem of postwar Germany is essential.

We should like an appointment with you at your convenience to discuss these matters.

Very truly yours,

(Signed)

MALCOLM PIRNIE, *President*
American Society of Civil Engineers

CHESTER A. FULTON, *President*
American Institute of Mining and Metallurgical Engineers, Inc.

ROBERT M. GATES, *President*
The American Society of Mechanical Engineers

CHARLES A. POWEL, *President*
American Institute of Electrical Engineers

GEORGE E. BROWN, *President*
American Institute of Chemical Engineers

PROGRAM FOR INDUSTRIAL CONTROL OF POSTWAR GERMANY

THE destruction of the plants, machines, utilities, tools, materials, and other essentials for peacetime living penalizes not only the owners of the materials destroyed, but the world as a whole.

Specifically, the fundamental fallacy of any proposal for the indiscriminate destruction of the German industrial system is that it fails to differentiate between the wartime and the peacetime economy of the Reich.

We are for one simple, clear objective—an effective industrial means to keep Germany from starting another war.

This objective should not be confused, especially before the war is even won, with the appropriate punishment of Germany or with the international arrangements for the long future to be made around the peace table by the representatives of the Allied Nations after victory is achieved.

This paper, therefore, does not deal with broad, complex postwar questions of diplomacy and international policy.

"Unconditional surrender" implies disarmament of the German armies, the surrender of all arms, munitions, airplanes, and other ordnance material in stock piles or in process. It also should include the elimination of all German war production facilities such as ordnance plants, munitions plants, submarine works, etc., and the control of raw materials required by war industries.

We make no suggestions as to the overall international treatment of Germany after surrender, but confine our statement to the permanent physical disarmament of Germany and to the subsequent steps to make it impossible for her to prepare industrially for another war.

With this sole aim in view, however, we must recognize that the German nation cannot arbitrarily be kept in economic and industrial subjugation. To do so would create an economic vacuum in Europe which sooner or later would be filled, either by the German nation itself or by the collaboration of Germany with other nations or individuals who would profit financially or politically, or both, by helping to develop Germany into a good market.

Germany must have its chance for recovery along peaceful lines after the war. Such recovery cannot come about through an economy wholly agricultural, even if that were practicable; or without industry to produce both for German needs and for the reconstruction of other nations of Europe; or without markets.

Germany must be disarmed and that part of its industrial plant devoted to armament destroyed. But it is equally necessary to create a plan which will (*a*) allow the German people to live a reasonably normal life; (*b*) permit the retention of peacetime German industry, and (*c*) keep an economic balance in Europe.

This, we are confident, can be done without giving German industry the independence it would require to prepare for war again, either secretly or overtly.

We recommend, therefore, not an indiscriminate destruction, but a selective restriction and control of German industry.

Germany and Europe and the world need the contributions which the German nation, freed from the domination of war lords, can make in the future, as it has made in the past, to the development of modern technology and scientific and industrial advance.

If allied controls force the German people into an unnatural existence and hold back national economic development in Europe, they will become even more unstable and subject to pressures and possibilities containing the explosive seeds of another war. We should plan, therefore, to create a minimum of controls and to avoid abnormal social dislocations.

Discriminating between peace and war economy, there are at least four industries which are the most essential for war purposes, and the least essential for a peacetime economy. They are: synthetic gasoline, for which there is no economical peacetime use, nitrogen fixation, special and high alloy steels, and airplane production, all of which must be vastly expanded to prepare for war.

The labor employed by all these four industries in peacetime is less than 2% of the total German labor force.

Therefore, Germany's capacity to make war would be eliminated by the following steps in regard to its industrial economy:

1. Eliminate all synthetic oil capacity and prohibit the recon-

struction of plants and the importation of oil beyond normal peacetime inventories. This would destroy the major part of Germany's internal oil resources. Coal is the raw material for synthetic oil. It is plentiful in Germany and only a small per cent is used in synthetic oil plants. It is not readily controllable in the Reich.

2. Eliminate 75% of Germany's synthetic nitrogen plant capacity and prohibit reconstruction of plants and all importation of nitrogen compounds. This will leave a capacity in Germany ample for peacetime nitrogen requirements. The principal ingredient of explosives is nitrogen. The relatively small amount of dynamite required for mining, quarrying, etc., should be under import control. Control imports of Chilean nitrates.

3. Eliminate 50% of Germany's steel-making capacity in those categories of plants which are most capable of producing essential war materials such as heavy forging and high alloy steels. Control imports of manganese, chromium, nickel, and tungsten, which are practically non-existent in Germany. Also prohibit importation of iron ore, flux material, steel and steel products beyond normal peacetime inventories.

4. Eliminate aircraft plants and equipment. Aluminum and magnesium are the raw materials required for airplane manufacture. There are no important bauxite deposits in Germany. Importation should be prohibited. Alumina and aluminum plants should be destroyed and importation of aluminum ingots beyond prewar peacetime needs be prohibited.

If any one of these steps were taken, war could not be waged nor prepared for. Taking all four would afford ample insurance against war.

By attacking the problem from this angle, it would be possible to set up uncomplicated, non-political controls to prevent the rearmament of Germany, but at the same time make it possible for the German nation to meet its own peacetime needs and thereby prevent her from becoming a drag on the economy of all Europe and a breeder of future wars.

Fifty or sixty per cent of all the German oil and gasoline supplies have come from synthetic coal distillation plants scattered throughout Germany. A third of her requirements have been derived from the Ploesti oil field in Rumania. The synthetic plants produce inferior products at a cost about four times world price. Their operation has required Government subsidy. These w plants should be demolished.

Eighty per cent of nitrogen is produced synthetically from th air, but it could not be produced without reconstruction of speci plants or without Chilean nitrates which Germany must import.

Germany could not make steel, produce oil products or mak munitions of war without imports of bulky, easy-to-police materials. Hence policing the curtailment of potential war production woul consist of (*a*) controlling the import of, or the accumulation of stocks o such bulk materials as petroleum, pyrites or brimstone, manganese chrome or nickel and iron ore, stee aluminum, and nitrogen compounds and (*b*) requiring periodic inspectio of plants and special revocable permit of construction or of operation of manufacturing facilities for any purpose.

Further insurance could be secure by transferring the ownership o management of the remaining nitroge and steel production plants into allied hands.

When the Allied Nations have carrie out the terms of unconditional surrender and have thereby rendered Germany harmless by disarmament for th next ten or fifteen years, a program o permanently disarming her must loo not to 15 but to 50 years. It is unrealistic to assume that any program pu forward to take the sting out of Germany will not require supervision an vigilance for a long period in the future.

The essence of this program is to remove from Germany th plant and source materials essential for war purposes, but to do i with the least disturbance to the normal economy of Wester Europe.

We do not believe that crippling the normal peacetime industria economy of any country, even an enemy nation, can promote worl peace and reconstruction. On the contrary, such a policy jeopardizes the peace and progress of all. We are opposed to any pla which would make postwar Germany a drag on the economy of al Europe, if not of the world, and a breeder of future wars.

(*Signed the same way as the letter which precedes.*)

Dues Canceled on Request from Members in the Armed Forces

AT its October meeting in Denver, Colo., the Board of Direction of the Society passed the following resolution regarding cancellation of dues of members in the armed services:

"Cancellation of 1945 dues is hereby extended upon request to all those members of the Society in the armed services of the United States who are enlisted personnel and, upon application for such cancellation, to those commissioned officers receiving base pay of $2,400 or less. Those who receive this exemption will continue to be listed as members of the Society; and those who are Corporate Members shall retain their voting rights. However, no publications except CIVIL ENGINEERING are to be forwarded to those thus exempted."

Meeting of the Board of Direction—Secretary's Abstract

THE BOARD met on Monday and Tuesday, October 9 and 10, 1944, at the Brown Palace Hotel, Denver, Colo., with President Malcolm Pirnie in the chair and George T. Seabury, Secretary; and present also Past-President Black; Vice-Presidents Agg, R. E. Dougherty, Hastings and Thomas; and Directors Bakenhus, Boughton, Breed, Burpee, Edwards, Gamble, Goodrich, Hathaway, Hollister, Lilly, Rawn, Scobey, Shannon, Tipton, Tolles, and Wilson.

Minutes Confirmed

Minutes of the meeting of the Board on July 17, 18, 1944, were approved as submitted, and similarly with minutes of the Executive Committee meeting of July 16, 1944.

Actions of the Executive Committee at its meeting on October 8 were reported individually. With confirmation by the Board, they are incorporated herein as actions of the Board.

Prize Awards

Reviewing the recommendations of the Committee on Society Prizes, the Board determined a number of awards for the current year. Details are given in a separate item.

Division Executive Committees

Following normal procedure, suggestions for new appointees to the Executive Committees of the Technical Divisions were acted upon. The list of new members, effective in January 1945, appear on another page.

Nominating Committee

Report was received by the Secretary from the Nominating Committee, designating its unanimous choice of John Cyprian Stevens of Portland, Ore., as official nominee for President in 1945. Mr. Stevens later wired his acceptance and appreciation. Details of this and other official nominations are given separately on another page.

Military Training

A committee was authorized, designated to study the practicability of combined universal military training and engineering education.

New Field Secretary

Appointment of Henry L. Thackwell, M. Am. Soc. C.E., as Field Secretary to serve the West Coast was confirmed.

Report on Depreciation

Final Report of the Special Committee on Depreciation was received and ordered to be published (see the November PROCEEDINGS). The Committee was discharged with thanks.

Employment Conditions

After considerable discussion of engineering employment problems, a number of decisions were reached: (1) To advise those petitioning a referendum to the Corporate Membership that the oard is continuing its studies of the question involved and collec- ion of information on the basis of which its future actions will be overned; (2) to send a questionnaire to the thirty Local Sections hich have amended their constitutions re collective bargaining, for he purpose of determining the extent of progress made; (3) to ecommend to every Section that it form a Committee on Employ- ent Conditions by such method as it may elect, the purpose of the ommittee being to be of service in all employment matters, in- luding conciliation of employer–employee difficulties and collective argaining. (See Report of the Committee on Employment Condi- ions, adopted by the Board as it appears on page 484).

djustment of Dues

Following recommendation of the Executive Committee, the oard decided to continue its policy of reducing the dues of native esident members of other countries so as to share equally with them ny unfavorable exchange rate. Similarly it was voted to extend or another year the provisions for canceling dues of members in he armed services receiving base pay of $2,400 per annum or less. ee notice on another page.

Reconversion

Resolution was adopted urging on the government that it specify hat at least one member of its national advisory board on recon- ersion be an engineer of ability and experience.

ndustrial Control of Postwar Germany

For the record, an open letter was reported to have been sent over he signatures of five engineering society presidents, including that f President Pirnie, to the State Department, urging the adoption f a "Program for Industrial Control of Postwar Germany." The nitiative of the presidents, as well as their recommendations, was pproved and commended. An item elsewhere in this issue gives urther details of the proposed control.

overnment Consulting Fees

A resolution was adopted advocating increase in the fees for overnment consulting service from the present $25 per diem to 100 or more per diem. See item on another page.

Milwaukee Salary Studies

Extensive report was made on the Society assistance rendered in rawing up classifications and salary recommendations for civil ngineering employees of the city and county of Milwaukee. (For etails see the September issue, p. 405.) The Board expressed its atisfaction.

Engineering Education

In general discussion considerable concern was expressed as to the ffects of present tendencies in engineering education, especially in he postwar period. The subsidizing of technical institutes was elt to have some inherent dangers.

Postwar Construction

A full summary was presented by the chairman, covering the ctivities of the Committee on Postwar Construction.

Other Committees

A number of Board Committees reported progress, including Membership, Publications, Securities, Professional Conduct, Local Sections, and others.

Honorary Memberships

Ballots were canvassed, resulting in the election of the following as Honorary Members: Arthur J. Dyer of Nashville, Tenn.; Arthur Surveyer of Montreal, Canada; Louis C. Sabin of Cleveland, Ohio; Maj. Gen. Charles P. Gross of Fort Myer, Va.; and Professor Horace W. King of Ann Arbor, Mich. For further details, see a separate item elsewhere in this section.

Districts and Zones

The Committee on Districts and Zones announced that no changes in the boundaries of Districts and Zones would be recommended for the year 1945.

General Matters

Many other questions were considered: the Society's Washington representative reported; budget items were revised as required; appointments were confirmed; and in general suitable action was taken on various matters presented.

Appreciation

Resolution of thanks for courtesies in connection with the Denver meeting of the Board was unanimously adopted.

Adjournment

The Board adjourned to meet in New York City on January 15–16, 1945.

J. C. Stevens Is Nominee for President, 1945

ACCORDING to the Constitution, the Nominating Committee has to meet and choose the official nominee for President of the Society before October 15 each year. Such a meeting was held in Denver on October 9. Choice for the year 1945 fell on John Cyprian Stevens of Portland, Ore., and he has accepted the nomination.

Because of his long membership in the Society and his extensive services, Mr. Stevens is well known to members generally. He has had wide experience in hydraulic work both in America and abroad, in the public service and in private practice. For almost thirty years he has had his own office in Portland, Ore., most of the time as partner in the firm of Stevens and Koon.

In the Society he served as a Director for the term 1932–1934, as long-time head of the Committee on Hydraulic Research, and in various other active capacities. He has been generous in his technical work for the Society, and in participation in its publications. Mr. Stevens can be depended upon to give an active, conscientious administration of his duties as president. A more extended review of his work will be given in a later issue.

Appointments to Division Executive Committees

A NEW member has been appointed to the executive committee of each of the various Technical Divisions of the Society, as given in the list below. These appointments, made at the meeting of the Board of Direction in Denver, were taken from lists suggested by the nominating committee of each Division. This procedure, provided for in the By-Laws, also establishes a term of five years for such committee members.

DIVISION	APPOINTEE
City Planning	Ladislas Segoe
Construction	(To be appointed by the Executive Committee of the Society)
Engineering Economics	L. K. Sillcox
Highway	Harold G. Sours
Hydraulics	W. H. Nalder
Irrigation	C. M. Ainsworth
Power	Joel D. Justin
Sanitary Engineering	John H. O'Neill
Soil Mechanics and Foundations	Frank A. Marston
Structural	Arthur J. Boase
Surveying and Mapping	J. S. Dodds
Waterways	Richard K. Hale

All these new appointees will take office in January 1945.

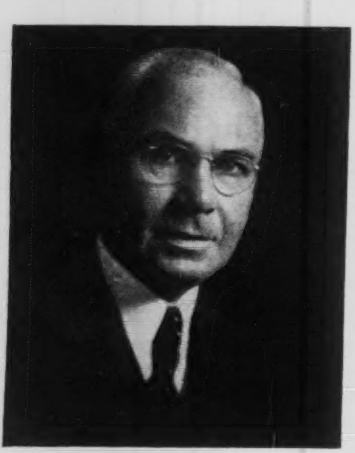
Appointments of Society Representatives

R. E. DOUGHERTY, M. Am. Soc. C.E., has been appointed one of the Society's representatives on United Engineering Trustees, Inc., for the four-year term expiring October 1948.

SHERMAN M. WOODWARD, Hon. M. Am. Soc. C.E., has been appointed to represent the Society on the Board of Award for the Marston Medal to fill the vacancy caused by the death of JOHN W. ALVORD, Hon. M. Am. Soc. C.E.

John Fritz Medal Goes to John L. Savage

THIS year's winner of the John Fritz Medal, which has sometimes been called the highest award of the engineering profession, is John L. Savage, Hon. M. Am. Soc. C.E. Mr. Savage, who is chief designing engineer for the U.S. Bureau of Reclamation and consulting engineer for the Tennessee Valley Authority, receives the award for "superlative public service, in conceiving and administering the engineering of mammoth dams, both in America and beyond the seven seas."



JOHN L. SAVAGE, HON. M. AM. SOC. C.E.

Born in Wisconsin in 1879, Mr. Savage graduated from the University of Wisconsin in 1903. He then became connected with the U.S. Reclamation Service (now the U.S. Bureau of Reclamation), where he has spent his entire career, with the exception of eight years in consulting practice with the late A. J. Wiley in Boise, Idaho. Since 1924 he has been chief designing engineer for the Bureau, in charge of the design of all its great projects constructed during this period. These enterprises include Boulder, Grand Coulee, and Shasta dams. Simultaneously, he has advised on the design of several of the TVA dams and has had important consulting assignments in Puerto Rico, South America, India, and Australia. The many honors that have come to Mr. Savage include election to honorary membership in the Society in 1941.

The John Fritz Medal Board of Award consists of four past-presidents of each of the Four Founder Societies. Previous recipients of the Medal, which is devoted to the recognition of distinguished contributions in the field of applied science, include Thomas A. Edison, George W. Goethals, Orville Wright, Guglielmo Marconi, and Herbert Hoover.

Testimonial Ceremonies at Retirement of H. A. Van Norman

OVER 20,000 friends and fellow workers met at the Shrine Auditorium in Los Angeles, September 29, to pay tribute to Harvey A. Van Norman, M. Am. Soc. C.E. Mr. Van Norman was General Manager and Chief Engineer of the Los Angeles Department of Water and Power before his retirement on October 1. He has served the department in various capacities for 37 years.

The program was significant not because of the number of speakers—there were many—or because of the size of the crowd, but because it directed attention to the attributes of character which can and, in the case of Mr. Van Norman, have earned success both in engineering and in public service. During the presentation of the testimonial, the characteristics of honesty, sincerity, and fairness which have marked this career were stressed.

Joining the department in 1907, Mr. Van Norman supervised construction of many of the units of the widespread Los Angeles power and water system and became assistant to the late William Mulholland on the Los Angeles Aqueduct. It was natural that on Mr. Mulholland's retirement in 1928, Mr. Van Norman should step into the position of Chief Engineer and General Manager of the system. In leaving he said, "Long ago I learned to cherish the friendship and respect of my associates. . . . I have always realized that without your help the tasks of management would have been almost insurmountable."

Succeeding Mr. Van Norman, Samuel B. Morris, M. Am. Soc. C.E., assumed his new duties on October 1. He came to the department from Stanford University, where since 1936 he has been dean of the School of Engineering. Mr. Morris is well known to members of the Society for his activity on various committees and as a past-president of the San Francisco Section.

Report of Tellers on Second Ballot for Official Nominees

October 16, 19

To the Secretary
American Society of Civil Engineers

The Tellers appointed to canvass the Second Ballot for Offic Nominees report as follows:

For Vice-President, Zone II		
A. C. Polk	1,058	
Void	2	
Total	1,060	
For Vice-President, Zone III		
Ernest E. Howard	884	
H. S. Morse	697	
Void	1	
Total	1,582	
For Director, District 1 (Two to be elected)		
Charles W. Bryan, Jr.	524	
Thorndike Saville	519	
Void	3	
Total	1,046*	
(* Actual number of ballots received	523)	
For Director, District 4		
Howard T. Critchlow	217	
Void	0	
Total	217	
For Director, District 11		
John H. Gardiner	346	
Void	0	
Total	346	
For Director, District 14		
H. F. Thomson	197	
Edward R. Stapley	110	
Void	0	
Total	307	
For Director, District 15		
Oscar H. Koch	389	
Void	0	
Total	389	
Ballots canvassed		4,424
Ballots withheld from canvass		
From members in arrears of dues	38	
Without signatures	29	
Total withheld	67	67
Total number of ballots received		4,491

Respectfully submitted,

FRANK L. GREENFIELD, *Chairman*
DAVID G. BAILLIE, JR., *Vice-Chairman*

HARRY NEWMAN	THEODORE P. KILIAN	ALFRED M. WYMAN
JOSEPH FARHI	JACOB MECHANIC	LOUIS GOODMAN
G. R. LATHAM	C. P. MELIORANSKY	HOWARD HOLBROOK
BERTALAN SCHOEN	ERNEST H. HARDER	*Tellers*

Board Acts on Consulting Fees

AT THE Denver meeting of the Board of Direction, action was taken with respect to consulting fees on federal projects. The resolution in full follows:

WHEREAS, the Board of Direction of the American Society of Civil Engineers has given consideration to the terms of Congres onal Acts which establish $25.00 per diem as compensation for e services of consulting engineers in connection with the design d construction of Federally sponsored projects, and

Whereas, such compensation is recognized as being wholly inadequate for the character of services required, and

Whereas, the best interests of the country cannot be served y such requirement for the reason that properly qualified prossional engineers of high ability and established reputation canot be expected to offer their services on such a basis,

Now, therefore be it Resolved that the Board of Direction of the merican Society of Civil Engineers, assembled in session on this 0th day of October 1944, protest the currently established fees d recommend that in future legislation a maximum fee of at ast $100 per diem be provided as a basis of compensation for the rvices of consulting engineers, and

Be it further Resolved that copies of this resolution be furnished o members of Congressional committees who may be concerned ith the framing of appropriate legislation from time to time.

Lantern Lectures for Student Chapter Use

Officers of Student Chapters will wish to have at hand a list f the lantern lectures available, as in previous years, for showing at Chapter meetings. The titles, as listed below, show the variety of ngineering topics covered in the series. Both slides and lectures re loaned to any Chapter (Local Section, or other interested body) ithout charge.

Lectures	Date Made
erial Photographic Mapping	1941
Bonneville Dam	1939
Boulder Dam	1938
Carquinez Strait Bridge	1930
Cascade Tunnel	1929
Catskill Water Supply	1939
Conowingo Hydroelectric Development	1929
Construction of Chicago Subway System (film included)	1942
Coolidge Dam	1930
Florianopolis Bridge	1930
Foundation Problems of West Side Elevated Highway—New York	1939
George Washington Bridge	1935
Golden Gate Bridge	1938
Grand Coulee Dam	1940
Hetch Hetchy Water Supply	1929
Holland Tunnel	1930
Miami Flood Control	1929
Mississippi River Flood Control	1940
Norris Dam	1939
Power Development at Niagara Falls	1929
Queens Midtown Tunnel	1942
San Francisco-Oakland Bay Bridge	1939
Tacoma Narrows Bridge Failure (film included)	1942
Waterloo Bridge (prepared by the Institution of Civil Engineers, London)	1943
Wheeler Dam	1939
Wilson Dam at Muscle Shoals	1929

Each of the lantern lectures consists of a mimeographed talk keyed to fifty or sixty slides. The simplest method of presentation obviously consists in reading the lecture while the slides are being shown. A much better method is for the lecturer to study the subject in advance, so that when the presentation is made he will use the written lecture merely as an outline for his talk, and may be able to answer questions from the floor. References are given to articles in Society publications, which furnish further information about each project.

Reservations should be made well in advance of the date when the slides are to be shown. Experience has proved that those who wait until the last minute have often been unable to obtain the desired lecture on short notice.

Final Report on Depreciation Published

The final report of the Special Committee on Principles of Depreciation has been approved by the Board of Direction and ordered printed in the November Proceedings. A previous progress report by the Committee was published in the June 1944 Proceedings, followed by discussions in the September and October issues.

Principles of depreciation, of such vital interest to civil engineers, became a subject of immediate concern to the Board of Direction when the National Association of Railroad and Utilities Commissioners published a report on depreciation in 1943. This 277-page volume presented conclusions and recommendations judged by engineering principles to be injurious to the public welfare. The President of the Society therefore appointed a Special Committee on Principles of Depreciation to study the full implications of that report.

Study by the Committee has been in progress for several months. The progress report was issued with the intent that extended discussion might profitably be held at the summer meeting to be held in Cleveland. Unfortunately this meeting was canceled at the personal request of the Director of the Office of Defense Transportation and it was therefore impossible to hold the discussion at that time.

A final report was prepared in time for the fall meeting. This comprehensive statement, comprising more than 30,000 words, was approved by the Board. Although the full report will appear in Proceedings for November, a limited number of reprints will be available. These reprints may be obtained from the Headquarters of the Society for 80 cents each, subject to the customary discount of 50% to members. For those interested, reprints of the progress report are also available at the same price.

Report of Committee on Postwar Construction

Compilations of statistics by the Committee on Postwar Construction of the American Society of Civil Engineers, based on reports supplied by McGraw Hill Co., show that both private and public engineering construction plans under way or completed between April 1, 1944, and October 1, 1944, represent a greater investment than all the projects reported for the 15 preceding months.

The increasing consciousness of civil authorities as to their obligation in providing a shelf of public works projects ready for bids during the first postwar year is indicated by the growth in dollar volume of construction blueprints in the last six months, equaling 91%.

Cumulative totals of plans in the design stage for two periods are shown in the following table (thousands—000's—omitted):

Classification	March 31, 1944	Sept. 30, 1944	% Increase
Public:	$2,135,728	$4,068,791	90.7%
Water works	91,877	260,948	
Sewerage	220,904	519,764	
Streets and roads	606,329	1,026,955	
Bridges	315,148	400,606	
Buildings	422,957	718,770	
Earthworks	191,778	644,710	
Unclassified	286,735	497,038	
Private Projects:	49,349	369,399	653%
Industrial buildings	6,164	31,716	
Commercial buildings	36,620	275,118	
Unclassified	6,565	62,565	
Federal government	157,875	578,614	
Total public and private	$2,185,077	$4,438,190	103%

While the reports of the last six months are encouraging, the total of $4.4 billion is still less than 1/3 of the $15 billion potential the Society believes necessary to have in the bidding stage July 1, 1945, as a construction program for the first year of peace.

The leading states listed below, and their reported volume of plans in the design stage, exclusive of federal government projects, provide 69% of the national total.

1.	New York	$1,029.1 million
2.	Ohio	460.5
3.	Michigan	292.9
4.	Texas	286.0
5.	California	198.2
6	Pennsylvania	186.9
7.	Washington	126.1
8.	Indiana	114.9
9.	New Jersey	102.8
10.	Maryland	95.1
11.	Illinois	91.4
12.	Connecticut	89.5
		$3,073.4 million
	Other states	1,364.8
	Total	$4.438.2 million

Sewerage, and streets and roads projects continue to show the greatest gains in the volume of plans in the design stage, indicating a large back-log of needed works in this category.

Sewerage projects last month increased about $63.7 million, or 14%. Michigan and New York provide $56.6 million of this increase.

Reports from Maine, New York, Illinois, Michigan, and Texas in September on streets and roads projects represented 86% of a national gain of $106.8 million.

For the second month, a fair increase in the volume of plans for private construction was reported, equaling $87.5 million. The present total of $369.4 million is disturbingly small, being about $^1/_{25}$ of the size believed necessary for the first year of peace.

Greetings from Venezuela

THE PRESIDENT of the National Engineering Society of Venezuela (Colegio de Ingenieros de Venezuela) extended greetings to the American Society of Civil Engineers during his recent visit to the United States. The occasion was the October meeting of the Metropolitan Section, which gave an enthusiastic reception to Dr. Edgar Pardo, Assoc. M. Am. Soc.C.E. After brief introductory remarks, Dr. Pardo went on to speak of the organization of which he is president, as follows:

"The Colegio de Ingenieros de Venezuela is an official corporation devoted to the progress of the profession and professional ethics. In addition, it takes care of the registration of the engineers in the different branches. It is compulsory for one to be a member of this corporation in order to be able to practice the engineering profession in Venezuela, and members are accepted only after establishing their legal and professional status as engineers.

"It is a special honor to me, for which I thank you most heartily, to address you as a representative of all the Venezuelan engineers. We Venezuelan engineers admire and respect the engineering achievements of the United States of America, and it has been our goal and our objective to bring our activities and technique to the North American standard.

"We realize, however—and it is evident—that material development is not sufficient to bring happiness and peace within countries and between the different countries of the world. To a great extent, the peace that we desire is not a natural consequence of life, but must be worked out by mutual knowledge and study of individuals, so as to understand the reasons for which they arrive at different ways of thinking and thus to achieve a mutual appreciation. There is no special group of individuals or activities devoted to these efforts; it is part of everyone's duty—and we engineers are no exception. I therefore want to express to you in the name of the Colegio de Ingenieros de Venezuela our desire for the most friendly collaboration and our wishes for the success of this Society and for the increasing greatness of the American nation."

Report of Committee on Employment Conditions

To the Board of Direction, Dated October 8, 1944

IT IS EVIDENT that the growth of the institution of collective bargaining, as represented by trades and labor unions, is accelerating, and that professional engineering employees are being increasingly absorbed into such bargaining groups.

In firm "A" more than three hundred professional engineering employees, in firm "B" approximately twelve hundred professional engineering employees, and in firm "C" about one thousand professional engineering employees have affiliated with trades and labor unions. Instances, noted in the press, although not confirmed, indicate similar inclusions of more than two thousand other professional engineering employees.

Undoubtedly some professional engineering employees desire affiliation with trades and labor unions, but there is evidence that in nearly all cases where group action is necessary, professional engineering employees have preferred to identify themselves with collective bargaining groups comprised exclusively of professional men.

The Board of Direction approved a method of procedure, optional to Local Sections, whereby employee members might avail themselves of the laws and regulations relating to collective bargaining, to form groups and units of their own and also to protect themselves from inclusion in or absorption by labor-dominated groups. The original procedure for Local Section Constitutional amendment, with the letter of interpretation of March 21, as published in the May 1944 issue of CIVIL ENGINEERING, with few minor exceptions, offers a good plan to meet the situation.

About half of the Local Sections have not amended their constitutions or provided for Committees on Employment Conditions in accordance with the recommendation of the Board, and it is now desired to suggest an alternative method whereby the remainder of the Sections may provide for such committees without the necessity of constitutional amendment. Unless there is obviously no means of doing so under the Local Section Constitution, the Section may proceed with the formation of such a committee on its own initiative, preferably in the manner hereinafter recommended by the Board.

It is recommended that every Local Section which so desires, form a Committee on Employment Conditions, either by the methods which have been proposed by the Board or by similar methods to be developed in the respective Sections. To be effective, Local Section Committees on Employment Conditions should be comprised of employee members of the Section. The Committee should activate and be supported by a group comprised of professional engineering employee members of the Local Section, and other professional engineering employees, who desire to affiliate with this group. There should be no difference in dues paid to the support of this group as between members of the Local Section and other professional engineering employees not members of the Local Section.

The function of the Local Section Committee on Employment Conditions should be advisory and educational; to keep alert to developments in employment conditions within the area of the Local Section; to negotiate and conciliate differences between employers and employees; and, where advisable, to facilitate, through the group, the formation of units appropriate for collective bargaining purposes, including aid in financing those units through funds collected exclusively from the dues of the group.

It is essential that the program of the Society in the matter of employment conditions as adopted by the Board be energetically continued.

Respectfully submitted,

WILLIAM N. CAREY
ASHLEY G. CLASSEN
CHARLES W. OKEY
RICHARD G. TYLER
A. M. RAWN,
Chairman

Make Reservations Early for Annual Meeting in New York

THOSE PLANNING to attend the Society's Annual Meeting in New York in January are urged to note that reservations at the Headquarters Hotel—the Commodore—must be made before December 15. The Meeting dates are January 17–19, 1945, and requests for reservations should be sent to the Hotel Commodore, Lexington Avenue at 42nd Street, New York, 17, N.Y. Those desiring reservations at the Engineers' Club, 32 West 40th Street, New York 18, N.Y., should also make them before December 15. It is hoped that no one will be unable to secure accommodations at either of these places because of failure to make his reservations in time—that is, before December 15.

As is well known, New York, like many other cities, now has difficulty in accommodating all her visitors. Therefore reservations, at whatever hotel, should be made well in advance of the Meeting date.

Winners of Society Prizes Announced

At the meeting of the Board of Direction in Denver, Society prize winners for 1944 were announced. Following is a list of the winners and their papers.

Ralph B. Peck, Jun. Am. Soc. C.E., the Norman Medal for his paper, "Earth-Pressure Measurements in Open Cuts, Chicago, Ill., Subway."

Nathan M. Newmark, Assoc. M. Am. Soc. C.E., the J. James R. Croes Medal for his paper, "Numerical Procedure for Computing Deflections, Moments, and Buckling Loads."

Eugene L. Grant, M. Am. Soc. C.E., the Thomas Fitch Rowland Prize for his paper, "Fundamental Aspects of the Depreciation Problem—Relationship to Competitive Industry."

Gordon R. Williams, Assoc. M. Am. Soc. C.E., the James Laurie Prize for his paper, "Drainage of Leveed Areas in Mountainous Valleys."

Walter L. Moore, Jun. Am. Soc. C.E., the Collingwood Prize for Juniors, for his paper, "Energy Loss at the Base of a Free Overfall."

All the papers for which these awards were made appeared in Volume 108 of Transactions. Although awarded in 1944, the ceremonies of presentation will not be held until the Annual Meeting in January 1945.

Louisiana Adopts Coordinate System

A Society-sponsored project met with some success when, on July 10, 1944, the Governor of Louisiana approved "an Act to describe, define, and officially adopt a system of coordinates for designating the positions of points on the surface of the earth within the State of Louisiana."

The program for the legislative adoption of state coordinate systems was initiated by the Joint Committee on Land Surveys and Titles, of the American Bar Association and the American Society of Civil Engineers. In 1943, at the request of this Joint Committee, the Council of State Governments examined the proposed legislation, approved it, and included it in a report on desirable state legislation. In continuation of this program, legislation for the adoption of such coordinate systems has been prepared for 37 states whose legislatures meet in regular session in 1945.

The Council of State Governments is entirely an organization for the states, being the secretariat for the Governors' Conference, the National Association of Attorneys General, the National Association of Secretaries of State, and the American Legislators' Association. The Council also works in close cooperation with the National Conference of Commissioners on Uniform State Laws.

While state officials will receive copies of the proposed legislation from the Council of State Governments, it is desirable that they also be informed of the public's interest in the matter. This can be accomplished through the sponsorship of the American Society of Civil Engineers, which is definitely committed to the support of such legislation. In reports published in the Proceedings of November 1938 and June 1940, the Joint Committee strongly approves of it. In the 1940 report, the Committee "recommends":

"That the Enabling Act designed for the establishment of state plane coordinate systems recommended by this Committee in the First Progress Report be pressed for adoption with as much vigor as possible."

The first state to formally adopt its coordinate system was New Jersey, where legislation for the purpose was personally sponsored by Prof. Philip Kissam, the present chairman of the Surveying and Mapping Division of the Society, and an organizer of the present program. In Louisiana, the latest state to officially adopt its coordinate system, the sponsorship of the Society was made effective through a special committee of the Louisiana Section appointed for the purpose. Glenn Cappel, M. Am. Soc. C.E., was chairman of that committee. The Louisiana legislature met on May 8, 1944. The coordinate bill was introduced on May 24, passed the Senate on June 20, passed the House on July 4, and was approved by the Governor on July 10.

To date the following states have given legislative approval to their coordinate systems: New Jersey (1935), Pennsylvania (1937), New York (1938), Maryland (1939), North Carolina (1939), Massachusetts (1941), Texas (1943), and Louisiana (1944). In 1939, the Georgia Coordinate System was approved for use in one county.

The 37 states for which similar legislation will be proposed for the attention of the 1945 legislatures are: Alabama, Arizona, Arkansas, California, Colorado, Connecticut, Delaware, Florida, Georgia, Idaho, Illinois, Indiana, Iowa, Kansas, Maine, Michigan, Minnesota, Missouri, Montana, Nebraska, Nevada, New Hampshire, New Mexico, North Dakota, Ohio, Oklahoma, Oregon, Rhode Island, South Carolina, South Dakota, Tennessee, Utah, Vermont, Washington, West Virginia, Wisconsin, and Wyoming.

Honorary Members Elected

In recognition of outstanding professional accomplishments, five engineers have been awarded Honorary Membership in the Society. Final action was taken by the Board of Direction during its October meeting in Denver, Colo., resulting in the election of the following:

Arthur James Dyer
Charles Philip Gross
Horace Williams King
Louis Carlton Sabin
Arthur Surveyer

All have acquired renown through extensive experience in their respective fields. Although his interests have been varied, Mr. Dyer has received recognition for his connection with structural design, fabrication, and construction. Following several interesting assignments, he became associated with the Nashville Bridge Company and for 38 years he served as president of this company. Always conscious of his civic duties, Mr. Dyer is at present serving as Director of Civilian Defense and Priorities Coordinator for Tennessee.

The field of endeavor chosen by Charles P. Gross is military engineering. Since graduation from the U.S. Military Academy, he has held posts of increasing responsibility until at present he is chief of the Army Transportation Corps, with the rank of Major General. General Gross has served at military posts throughout the United States and on several foreign assignments. When in December 1943 a serious strike threatened the railroads, they were taken over by the Army and General Gross was made responsible for all operations.

Horace W. King, in addition to an outstanding reputation as an educator, has gained widespread recognition for his activity in the development of water power policies. As an inventor and author, Professor King has shared his knowledge of hydraulics with others of his profession throughout the world. Perhaps his greatest distinction, however, has been his teaching, as has been attested by hundreds of his students at the University of Michigan.

It is for his work on the St. Mary's Falls Canal that Louis C. Sabin is best known. For nearly 20 years he was general superintendent of this navigation facility at Sault Ste. Marie. One of the most important undertakings during this period was the construction of a new navigation canal with two locks which have passed nearly 2 billion tons of freight. Mr. Sabin is at present vice-president of the Lake Carriers' Association, dealing with navigation problems on the Great Lakes.

Arthur Surveyer has had for many years an extensive consulting practice in Canada. His firm has designed and supervised many important engineering works and made investigations for utilities, industrial organizations, and investment firms. His experience in the field of hydraulics led to his appointment on the St. Lawrence River Commission and to his service with numerous other Canadian organizations.

In a later issue of Civil Engineering a more extended account of the accomplishments of these notable engineers will be given. The awards will be presented during ceremonies forming part of the Society's Annual Meeting inJanuary 1945.

News of Local Sections

Scheduled Meetings

ARIZONA SECTION—Annual fall meeting in Phoenix on November 25, beginning 9:30 a.m.

CINCINNATI SECTION—Joint meeting with the Engineering Society of Cincinnati at the Herman Schneider Foundation on November 21, at 8 p.m.

CLEVELAND SECTION—Dinner meeting at the Cleveland Engineering Society on November 17, at 6:30 p.m.

COLORADO SECTION—Dinner meeting at the Edelweiss Restaurant on November 6, at 6:30 p.m.

CONNECTICUT SECTION—Dinner meeting at the University Club on November 21, at 6:30 p.m. (Subject: "Improvements in Hartford and Plans for the Future.")

DAYTON SECTION—Luncheon meeting at the Engineers' Club on November 20, at 12:15 p.m.

ILLINOIS SECTION—Luncheon meeting at the Chicago Engineers' Club on November 9, at 12:15 p.m. (Subject: "Concrete Construction in South America.")

LEHIGH VALLEY SECTION—Meeting in the Packard Laboratory, Lehigh University, on November 13, at 8 p.m. (Subject: "Flood Control in Lehigh River and Delaware River.")

LOS ANGELES SECTION—Dinner meeting and annual ladies' night at the University Club on November 8, at 6:45 p.m.

METROPOLITAN SECTION—Technical meeting in the Engineering Societies Building on November 15, at 8 p.m.

MIAMI SECTION—Dinner meeting in the El Comodoro Hotel on November 2, at 7 p.m.

MID-SOUTH SECTION—Annual fall meeting in Vicksburg, Miss., on November 17, at 9:30 a.m.

NEW MEXICO SECTION—Lecture at the University of New Mexico on November 15, at 7:30 p.m. (Subject: "Concrete Failures.")

NORTHEASTERN SECTION—Dinner meeting at the Engineers' Club on November 13, at 6 p.m. (Subject: "Meteorology.")

NORTHWESTERN SECTION—Dinner meeting at the Campus Club on November 6, at 6:30 p.m.

PHILADELPHIA SECTION—Dinner meeting at the Engineers' Club on November 14, at 6 p.m.; meeting at 7:30 p.m.

SACRAMENTO SECTION—Regular luncheon meetings at the Elks Club every Tuesday at 12 m.

ST. LOUIS SECTION—Annual banquet at the Coronado Hotel on December 2.

TENNESSEE VALLEY SECTION—Annual meeting at Watts Bar Dam, Tenn., on November 4, leaving Knoxville and Chattanooga 8 a.m.

TEXAS SECTION—Luncheon meeting of the Dallas Branch at the Adolphus Hotel on December 4, at 12:15 p.m.; luncheon meeting of the Fort Worth Branch at the Blackstone Hotel on November 13, at 12:15 p.m.

TRI-CITY SECTION—Dinner meeting in the Fort Armstrong Hotel on November 16, at 6:30 p.m.

Recent Activities

BUFFALO SECTION

The development and use of air-entraining portland cement was the subject of discussion at the luncheon meeting held on September 20. Joseph C. Pearson, director of research for the Lehigh Portland Cement Company at Allentown, Pa., was the principal speaker, and his interesting presentation evoked considerable discussion from the floor.

COLORADO SECTION

At the September meeting of the Section—held in Denver on the 11th—Royce J. Tipton, Denver consultant and Society Director, spoke on the water treaty between the United States and Mexico. In his talk Mr. Tipton outlined the conflict in interests betwe the two countries. The activity of the Mexican government in th construction of pump headings along the Rio Grande and storag reservoirs on its irrigation projects indicates the possibility future control of the waters of the Lower Rio Grande River. O the other hand, the United States under ultimate possible cond tions could deprive Mexico of all water in the Lower Colorad River by storage and irrigation utilization, although Mexican irr gation demands in the Lower Colorado basin have been increasing Mr. Tipton then explained the proposal being instrumented by th Six States Committee to effect a treaty between the United State and Mexico to define water uses by Mexico, with the idea of avoiding embarrassing situations in the future.

CONNECTICUT SECTION

A paper on "Pollution Abatement in Connecticut"—given b William S. Wise, chief engineer of the Connecticut State Wate Commission—comprised the technical program at a meeting of th Section held on September 20. Mr. Wise pointed out that th abatement of stream-pollution problems involves a number of complex and intangible factors, such as stream size and characteristic character and volume of wastes, natural laws and self purificatio local conditions and needs, and the multiple uses made of wate courses. There is an economic balance, he continued, that determines for what purposes a stream can or should be used. Thus reasonable classification of all waterways in a state or region, designed to restore and maintain them in a state of purity economically feasible, provides a foundation upon which a pollution-abatement program can be developed.

DAYTON SECTION

The Dayton Section initiated its fall program on September 1 with a luncheon at the Engineers' Club. The high light of th occasion was a talk on the subject of "Ground Water in Ohio," given by David H. Harker. Mr. Harker is chief of staff of th Ohio Board of Water Supply.

GEORGIA SECTION

Speaking at the September meeting of the Georgia Section, Co Blake R. Van Leer outlined the needs and plans of the civil engineering department at the Georgia School of Technology. I discussing civil engineering in the postwar period, Colonel Va Leer said he expected the greatest activity in the fields of city an community planning, water works, sewage disposal, airport desig and construction, earth moving, and light building construction In closing, he predicted a rebirth of interest in civil engineerin education. Colonel Van Leer is president of the Georgia School o Technology.

HAWAII SECTION

The Hawaii Section announces that it is again active, and that al members of the armed forces who are stationed in, or passin through, Hawaii are cordially invited to attend the technical meetings that are held in Honolulu. The third meeting of the 194 season took the form of a buffet supper, followed by a talk b Frederick Ohrt, manager and chief engineer of the Honolulu Boar of Water Supply. Mr. Ohrt's subject was the "Water Supply o the City of Honolulu." A number of members and guests joine in the ensuing discussion.

IOWA SECTION

The September meeting of the Iowa Section—held at Ames o the 12th—took the form of a joint session with the Iowa Stat College Student Chapter. The speaker of the occasion was Henr Penn, district engineer for the American Institute of Steel Construction. His subject, "Steel Bridges," was illustrated wit slides.

LOS ANGELES SECTION

On September 13 members of the Los Angeles Section hear George Havas, chief engineer of the Henry J. Kaiser Company, te the story of this colorful and dynamic organization. Followin the usual dinner and introduction of guests by President McCreery, Mr. Havas traced the growth and development of the Kaiser organization from its modest start as the Kaiser Paving Company, through the rapidly expanded steps of sand and gravel, cement an steel, and other construction products, to the present enormo eation which builds so much in so short a time. Contrary to general opinion, Mr. Havas stated, the top men in the Kaiser organization are all engineers, and engineering and its adjuncts are an essential part of their operations.

Louisiana Section

Members of the New Orleans Chapter of the American Institute of Architects and of the Louisiana Architects Association were guests of the Louisiana Section on September 5. A talk, entitled "A Decade of Technical Developments in Timber Construction and Materials," comprised the technical program on this occasion, the speaker being Walter Scales. The speaker at the October meeting of the Section was Col. Vere A. Beers, of the Army Service Forces Training Center, who has recently been in the southwest Pacific. Colonel Beers' subject was "An Engineer Regiment at Work in the South Pacific."

Maryland Section

Guests of the Maryland Section at its September meeting were Society Director Gail Hathaway, and F. Barnes, L. Ott, and A. C. W. Siecke, all of the Merritt-Chapman and Scott Corporation, of New York City. The latter, who is consulting engineer for the organization, was the speaker of the evening, his topic being "Engineering High Lights of the Normandie Salvage." With the aid of slides, Mr. Siecke gave a detailed and interesting exposition of the engineering features of the job from the beginning until the ship was righted by means of controlled pumping.

Oklahoma Section

On September 16 members of the Oklahoma Section met at Tulsa for afternoon and evening sessions. Following a discussion of Section and Society business, a series of slides, entitled "The Solar House—Daylight Engineering in the Homes of Tomorrow," was shown under the auspices of the Libby-Owens-Ford Glass Company. Then R. E. Means, professor of architecture at the Oklahoma Agricultural and Mechanical College, presented a paper on the analysis of concrete building frames. Members of the Oklahoma chapter of the American Institute of Architects were guests of the Section for the technical phases of the program. The evening was given over to a dinner and discussion of a paper on dual purpose reservoirs, which was given by W. C. Burnham, hydraulic engineer for the Southwestern Power Administration.

Philadelphia Section

Nearly all of the Section's living past-presidents were guests of the Section at its annual meeting, which took place at the Engineers' Club on June 13. They were introduced by President Critchlow and greeted with hearty applause. During the business session that followed dinner the following new officers were elected for the coming year: Francis S. Friel, president; Lemuel F. Parlette, vice-president; and Charles A. Howland, secretary-treasurer. Following brief talks by Mr. Critchlow and Mr. Friel, Harold C. Davis gave an illustrated talk on China and the Burma Road. Mr. Davis, who is director of operations for Associated Transport Inc., spoke from first-hand experience gained while serving as a member of a three-man commission sent to China to study the problem of speeding traffic on the Burma Road.

Sacramento Section

Dean Morrough P. O'Brien, of the College of Engineering of the University of California, spoke on the "Outlook for Engineering on the Berkeley Campus" on September 5. He predicted a more liberal curriculum, freed of the drudgery of subprofessional assignments and embellished with courses in the humanities. Former presidents Drury Butler and Fitzhugh Turner were the speakers on September 12 and 26. The former summarized the effects of invention on the iron and steel industry, while Captain Turner reported his experiences in the Transportation Corps, organizing railway battalions for service in India. Since this work is now finished, Captain Turner has returned to his former position as division engineer for the Southern Pacific.

South Carolina

The annual summer meeting of the South Carolina Section—held in Columbia on July 26—took the form of a joint session with the South Carolina Society of Engineers. Speakers appearing on the technical program were A. H. Dierker, chief metallurgical engineer for the Pittsburgh Metallurgical Company, Charleston, S.C.; H. G. Harvey, Southeastern engineering and service manager, Westinghouse Electric and Manufacturing Company, Atlanta, Ga.; J. W. Lindau, III, Southern Plastic Company, Columbia, S.C.; and Rear Admiral J. T. Mathews, CEC, U.S. Navy, superintending civil engineer at New Orleans, La. In addition to the technical program, there were also a business session and banquet.

Student Chapter Annual Reports

Abstracts of Reports as Provided by the Society's Committee on Student Chapters. These Reports Cover Roughly the Period from June 1942 to December 31, 1943, Because of the Change in the Student Chapter Fiscal Year. Other Abstracts Appeared in the October Issue

University of Idaho

Prevailing conditions make it extremely difficult to carry on Student Chapter activities in a satisfactory manner. The University of Idaho has the Army Specialist Training Program's accelerated schedules, which deprive students of the time usually devoted to such activities, and the interest and enthusiasm normally shown by students are lacking. However, Contact Member William P. Hughes and other leading engineers of the state have been of great assistance in keeping the Student Chapter in touch with affairs of professional interest. Also cooperative relations with the neighboring Chapter at Washington State College have been helpful and pleasant.

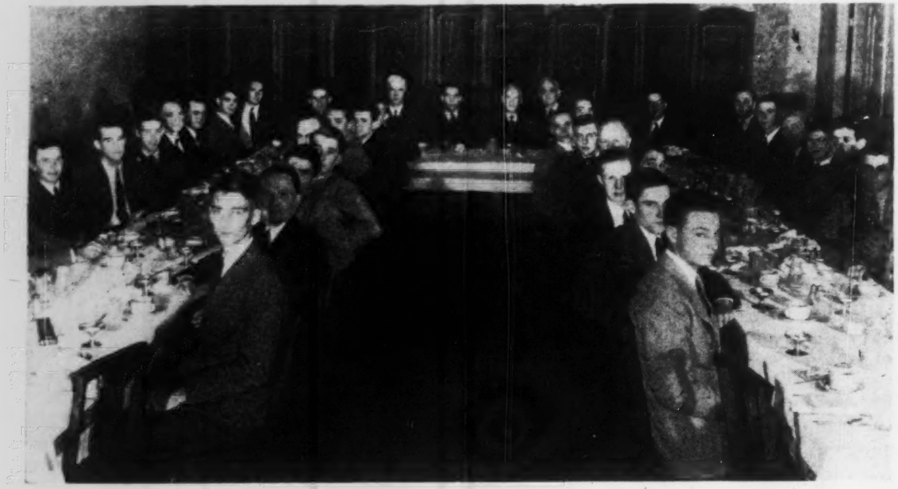
University of California

In spite of the war, the University of California Student Chapter has had a very successful school year. Membership did not suffer any severe drop, since most of the upper-division engineering students were allowed to continue through the Army, Navy, and Marine enlisted reserve programs. Thus it was possible to have a well-developed program of activities, including informal smokers, room meetings, a senior banquet, and a field trip. With war plants maintaining strict policies about visitors, field trips were harder to arrange. However, one interesting trip was taken to the Berkeley plant of the California Corrugated Pipe Company. And though the plants themselves were closed to the Chapter, many well-known engineers gave of their time to address the room meetings. In the field of campus activities the Chapter was well represented, and one member was chosen class valedictorian for the entire university.

University of California Chapter Concentrates on Food at Spring Picnic

STANFORD UNIVERSITY

During the 1942–1943 academic year the Stanford University Chapter functioned with reduced members but with sustained interest. An important feature of the Chapter has been the close contact between students and faculty, as evidenced by the holding of social meetings in faculty homes. Only three members of the Chapter returned to the university in September, but it was determined to keep the Chapter on an active basis. Army officers were most cooperative in allowing A.S.T.P. students to participate in Chapter meetings, so the Chapter enjoyed a successful year in spite of handicaps. The programs were varied and interesting, and the last meeting of the year consisted of a barbecue at Professor Moser's. The Chapter furnished the food—chicken instead of steaks this year—and invited faculty members and their wives and the wives of married students.



ANNUAL INITIATION DINNER FOR STANFORD UNIVERSITY STUDENT CHAPTER

The Chapter purchased about $50 worth of books for the engineering library from its funds. The books, selected by the president of the Chapter and the Faculty Adviser, have been placed in the "new book" shelf of the engineering library and each carries a sticker indicating that it is a gift of the Stanford Student Chapter.

NEWARK COLLEGE OF ENGINEERING

The period covered by this report—October 1942 to January 1944—is probably the most unusual encountered in the twenty-three year history of the college. Activities of the Chapter were not badly disrupted until June 1943 when many members were inducted into the Armed Services. Such difficulties, however, merely intensified the desire of our members to keep up the reputation of the Chapter. Since the other professional groups at the college, representing the Founder Societies, were also hard hit, the problem was finally solved by forming a Joint Society for their mutual advancement. However, individual meetings of our group were continued in addition to our participation in the activities of the Joint Society.

UNIVERSITY OF TOLEDO

The University of Toledo was classified as an accredited institution in the fall of 1942. At that time there was an organization on the campus composed of civil engineering students, and social events as well as the technical meetings enticed a great majority of the members. The accrediting of the school gave the members of this organization the chance they had dreamed of—they were finally eligible to establish a Student Chapter. This task they undertook wholeheartedly with the expert guidance of faculty members. Then in May the good news arrived that the organization had been accepted as a Society Student Chapter.

High lights of the year included the annual High School Day, when all high school seniors from Toledo and neighboring schools are guests of the university so that they may get an idea of the advantages of attending the university. On this occasion the Student Chapter presented an elaborate classroom display, and members were on hand to demonstrate the use of the instruments exhibited. The display was popular, and the civil engineering students were congratulated upon being first to organize a Student Chapter sanctioned by one of the Founder Societies.

During the summer of 1943 the effects of the war began to be apparent. In fact, the thoroughness with which our ranks were depleted by calls to the Armed Services was amazing. By September only two members were left. We strove to revive the organization but found ourselves handicapped by decreased enrolment and lack of upper classmen. We endeavored to encourage freshmen as associate members and were successful to a limited degree, though the problem of membership is still great. We feel, however, that we are not alone in this predicament, as other Chapters are undoubtedly encountering the same difficulties.

UNIVERSITY OF MICHIGAN

The Student Chapter at the University of Michigan reports the completion of a successful school year from both the standpoint of engineering education and good fellowship. Wartime conditions have restricted inspection trips and programs, canceled the North Central Student Chapter Conference and the 1943 annual banquet, reduced our members, and forced heavier programs on those left, but we have still had a profitable and enjoyable year. At one of our 21 meetings, the program consisted entirely of papers by students. This experiment of presenting student speakers proved to be most successful, and it is hoped that it may be continued at intervals in the future. Much of the success of our programs during these troublesome days has been due to the time so generously given us by members of the civil engineering department, and we wish to thank them and our adviser, Prof. W. J. Emmons, for the time so freely given.

GEORGIA SCHOOL OF TECHNOLOGY

The past year for the Georgia School of Technology Chapter has been one of continual change. Membership numbers and personnel changed constantly because of enlistments in the Armed Services and the temporary return of some to the school under the Army–Navy training program. The Chapter made the best it could of such a situation and managed to remain active even when only a few members were enrolled in school. At the present time, the Chapter is just as active as it was in prewar days, and all indications are that it will remain this way after weathering a very bumpy year. The most important event of the Chapter year was attendance at the Society meeting held in Atlanta in October 1943.

PENNSYLVANIA STATE COLLEGE

Membership in the Pennsylvania State College Student Chapter is voluntary and varied greatly during the period covered by this report. Membership decreased from 60 on July 1, 1942, to 17 on December 31, 1943, these figures representing 55 and 46% of the students eligible for membership. This reduction in total membership has been caused not only by reduced enrolment but also by accelerated college programs and heavier schedules. Students in the Army Specialized Training Program are not granted passes to attend meetings and have therefore taken no part in Chapter activities. In spite of these handicaps, the Chapter prepared a series of interesting and instructive programs for its 15 meetings.

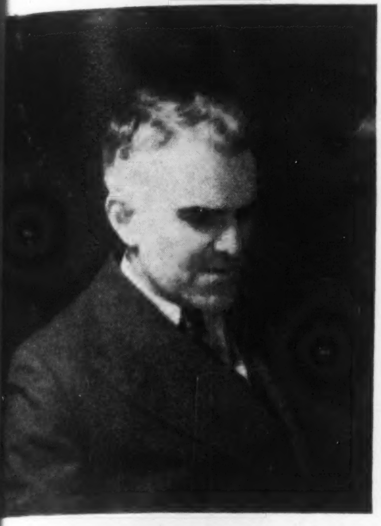
A record of the regular meetings might almost be had from the issues of the *Tripod*, edited and published by the Student Chapter. This paper covers the activities of the members and caters to special engineering student interests.

UNIVERSITY OF NOTRE DAME

The University of Notre Dame Student Chapter was organized on February 11, 1943. Prior to this time there was a Civil Engineering Club, which was not affiliated with the Society. Students enrolled at the university for their third semester of civil engineering are eligible for membership. In general, the monthly meetings are planned to promote the interests of the Chapter, both technically and socially. Lectures and movies on various engineering projects take care of the educational aspects, while social relations are encouraged by informal club dinners.

University of Wisconsin

Because of the war the Student Chapter at the University of Wisconsin has suffered a considerable decline in membership. In the fall of 1942 we had 76 members, but by the summer of 1943 Selective Service and enlistments had cut deeply into our ranks, causing a decrease to 30 members. Nevertheless, we have attempted to carry on as successfully as possible under existing conditions in order to keep the Student Chapter a prominent organization on the campus.



James G. Woodburn, M. Am. Soc. C.E., Faculty Adviser for University of Wisconsin Chapter

Under the accelerated war program, the college of engineering conducted a term of classes through the summer, and regular meetings of the Chapter were held. In fact, the Chapter has not only continued to function as a civil engineering organization, but has cooperated with the other engineering societies in various campus events. The general trend of the programs has been toward lectures and instructive motion pictures. The idea of presenting papers by student members has not struck a responsive chord in the Chapter.

Rose Polytechnic Institute

At Rose Polytechnic Institute the Chapter has held its own, despite the advent of the Army Specialized Training Program and a heavy decrease in the number of civilian students. The work of the Chapter has been much the same as in the past. The several war plants constructed in and near Terre Haute have afforded us an opportunity of getting first-hand information on some of the phases of the construction program. A meeting especially enjoyed was the field inspection trip through the new Terre Haute Ordnance Depot on September 18, 1942. Later, the Chapter was represented at the Midwestern Regional Conference of Student Chapters held at the University of Illinois. Our delegates brought back reports of a very interesting and successful meeting.

Other high lights included a joint meeting with the Indiana Section and the Student Chapter at Purdue University on September 4, 1943. The session opened with a chicken dinner served in the Rose gymnasium. The speaker of the evening was G. H. Hickox, senior hydraulic engineer of the TVA, who discussed the hydraulic work of this organization and explained in detail the value of experimenting with scale models before attempting any major work. During the evening the Indiana Section awards of Junior membership in the Society were presented to George Siu, of Purdue University, and E. H. Stanfield, of Rose Polytechnic Institute.

Southern Methodist University

Since the last annual report was submitted, the U.S. Navy selected Southern Methodist University to train future naval officers, and this necessitated a basic change in the engineering school. The cooperative plan was temporarily discontinued in favor of the Navy College Training Program of three 16-week terms per year with no opportunity for cooperative employment. The prescribed schedule, as approved by the Navy officials in charge, provided ample time for regular Student Chapter meetings, although tire and gasoline shortages prevented field trips. The practice of holding joint meetings of the several student chapters on the campus was found to be so successful that it may be continued after the war.

In spite of the necessity of starting the year with almost entirely new personnel, the Chapter made considerable progress and enjoyed a highly successful year.

University of Arizona

Since none of the officers elected for the 1943–1944 school year returned to school in the fall, it was necessary to set the constitution aside and elect officers from the sophomore class. There are on our campus 14 fifth-term civil engineers and 48 fourth-term civil engineers in the Army Specialized Training Program. These men are interested in the Student Chapter, and a number of them will attend meetings though they do not have time to take an active part in the programs. The meetings held last year were quite successful, although the attendance was not large. Most of our graduating seniors applied for Society membership as Juniors. We expect to hold two or three meetings within the next two or three months and keep the Chapter alive as best we can.

University of Texas

Though restricted in its activities, the University of Texas Student Chapter has had a creditable year. Because of gas and food rationing, social functions were limited. However, there was a fine Christmas party, which was attended by a large group of students and their dates and faculty and wives. Professor Focht led the group in square dancing. In the fall of 1943 a picnic and touch football game between seniors and juniors were enjoyed. Transportation difficulties and the accelerated programs in all Texas schools necessitated cancelation of the usual Student Chapter Conference, although the Chapter did assist the Texas Section at its fall meeting.

The most serious difficulty encountered was inability to interest sophomores and juniors in the Chapter and in the value of professional associations. However, every senior was a member of the Chapter.

University of Utah

The University of Utah continues to function in an eminently satisfactory manner. Faculty, engineers from all over the state, and others addressed the Chapter on a wide variety of subjects. These talks were technical, inspirational, and historical in nature. Many stressed cultural values, and particular effort was made to impress Chapter members with the necessity of speaking and writing correctly.

Kansas State College

During the past year many of the activities of the Chapter have been greatly decreased—chiefly as a result of decreased enrolment, inability to obtain adequate transportation, and wartime restriction of materials. The results of these curtailments have been manifold. The senior inspection trip, the annual student conference, and the joint meeting with the Student Chapter at the University of Kansas have been discontinued, and the annual Engineers' Open House was canceled. Despite these restrictions, interest in the Chapter has been maintained at a high level. Although several good speakers were obtained, a substantial part of the year's activities was carried out by the members of the Chapter. From this participation in the program much information and experience have been gained.

Caught in a Busy Moment
Members of the Kansas State College Chapter Model a Channel

IOWA STATE COLLEGE

Student Chapter activities at Iowa State College, during the past year, were influenced by the change in personnel, from civilian to one primarily of servicemen. Programs were adjusted accordingly. Although most of the meetings were technical in nature, there were a few social occasions, including the Fourth Annual Roundup of the Civil Engineering Department, which was sponsored by the Chapter at the beginning of the 1942 fall term. The scene of this gathering was Lynn Fuhrer Lodge—a cabin reminiscent of pioneer days and a delightful location for a civil engineers' get-together. From mid-afternoon until the welcome chow call, the group indulged in impromptu soft-ball and football games. After a hearty supper of baked beans, the usual group singing was led by one of the members.

STUDENT CHAPTER GROUP AT IOWA STATE COLLEGE

Technical programs during the year covered a wide range of subjects particularly interesting to engineering students during the war period. The annual banquet, which is a joint meeting with the Iowa Section, was a high light in the year's activities. The speaker of the evening was Claude Coykendall, and his subject the "Alaskan Highway." Mr. Coykendall was one of the organizers of the Iowa contractors engaged in this work.

UNIVERSITY OF KANSAS

Activities of the University of Kansas Student Chapter have been somewhat curtailed by the war. Nevertheless, the Chapter submitted an excellent report, and the enthusiasm of the members of the Chapter has been maintained in spite of the handicap of reduced enrolment.

PURDUE UNIVERSITY

At the present time (December 20, 1943) Purdue University is going full speed ahead with the war effort. With the Army Specialized Training Program and the Navy group the total student enrolment is approximately the same as in the pre-Pearl Harbor days. Thus the Student Chapter has been able to function quite efficiently. Meeting programs for the period included four talks by prominent engineers. Two of these were Presidents of the Society. On December 8, 1942, President E. B. Black spoke on war conditions as they affected the Society. The other Society President whom we were privileged to hear was Ezra B. Whitman, of Baltimore, Md., who addressed the annual banquet, held on June 12, 1943. This was a joint meeting with the Indiana Section.

CARNEGIE INSTITUTE OF TECHNOLOGY

The war takes precedence over other activities at Carnegie Institute and affects all our lives. Registration in January 1943 found only the sophomores and juniors remaining as members of the Student Chapter. The seminar meetings began as usual, but before the term ended it was found exceedingly difficult to obtain speakers. Thus the meetings were temporarily discontinued. It was not until the fall term that the regular seminar meetings could begin. At this time, the advanced R.O.T.C. class that was called in May returned to the campus, and four civil engineering students returned with this group. Speakers were scheduled for half the weekly meetings, and the seniors spoke at the rest of them. Transportation difficulties, regulations against admission to the defense industries and vital structures, and the lack of private construction projects restricted our field trips.

In November 1942, our Chapter was informed that it had been awarded honorable mention for outstanding work among the Student Chapters of the Society. The Chapter takes special pride in this honor, particularly since it has received the award five times in eight years.

RENSSELAER POLYTECHNIC INSTITUTE

Almost immediately after the outbreak of war in December 1941, Rensselaer Polytechnic Institute went on a speed-up schedule, which meant that to get the new officers installed before the seniors departed, it was necessary to hold our elections in November 1942. This was the first of many adjustments, which it has been found necessary to make. Affairs then went along fairly smoothly until the spring of 1943, when a great number of students were called up with the Army Enlisted Reserve Corps, and our activities were virtually suspended for a while due to the uncertainty of the situation.

In July school was opened under the V-12 program of the Navy, and after everyone had gotten used to the feel of new things a meeting of the Student Chapter was held. In the middle of October the election of new officers was held. At this meeting a highly successful membership drive was started, and at the time of this writing the Chapter membership is again up to about 70, which includes members from all four classes. The first activity of the Chapter, under the new officers, was a joint meeting with the Mohawk-Hudson Section of the Society.

UNIVERSITY OF ILLINOIS

The Student Chapter at the University of Illinois has been handicapped during the past school year in securing outside speakers because of the transportation difficulties and the fact that most technical men are busy helping the war effort. Thus the Chapter turned to talent at hand and, in so doing, discovered how much was to be had in or around the campus. The programs were varied to give pertinent information on many current problems.

Early in the 1943–1944 semester it was apparent that something should be done about filling the vacancies caused by inductions into the Armed Services. Thus a membership drive was organized. The engineer students in the Army and Navy and civilians were contacted, with the result that 48 new members were obtained.

On November 13 and 14, 1942, we were host to the second annual Midwestern Regional Conference of Student Chapters. In planning the conference, consideration was given the fact that many conferences had been postponed for the duration. However, the committee decided that, in addition to fostering desirable relations among the Student Chapters, the Conference could direct the students' minds toward the application of engineering to the war effort, and the program was prepared with that end in view.

UNIVERSITY OF COLORADO

In common with other colleges, the University of Colorado has modified its program to meet the wartime needs of the country, and the Student Chapter has been affected accordingly. From September 1942 to June 1943, the Chapter carried on as usual with student papers, outside speakers, and technical films. In July 1943, the university changed the academic year, based on the quarter system, to a three-term calendar year to meet the requirements of the Navy V-12 program. In November 1943, approximately 850 engineering students were detailed to the Colorado campus by the Navy. In general, these students have shown marked interest in the Chapter, but changes in methods of operation have been required. It is no longer practicable to schedule many student programs, and limitations on the time of V-12 students have made it desirable to hold meetings once a month instead of every two weeks. During the last six months of 1943, the Chapter operated successfully on the revised basis. A visit from Dean F. M. Dawson, of the University of Iowa, addresses by a number of Denver engineers, and a beefsteak fry have been important factors in maintaining the Student Chapter on a functioning basis.

ITEMS OF INTEREST

About Engineers and Engineering

Chilean Engineers Studying in U.S.

When the Government of Chile decided in 1939 to undertake a program of national industrialization, it wisely included the proper training of its young engineers. With the object of providing trained personnel coincident with the development program, the Fundacion Pedro Aguirre Cerda was established by the Corporacion de Fomento de la Produccion, an instrumentality of the Chilean Government for the development of the natural and industrial resources of that country and popularly referred to as "Fomento." It is analogous to our own RFC, TVA, FHA, and similar governmental agencies. The head office is in Santiago, and the New York office is at 120 Broadway.

Training under the Pedro Aguirre Cerda Fundacion contemplates that young men from Chile shall complete the requirements for an undergraduate or a graduate degree while receiving practical field experience in the United States in their particular branch of engineering during the day and attending American universities in the evening. Thus, coincident with his evening studies and the fulfillment of theoretical requirements for his degree, the trainee works during the day in a large organization, rotating from department to department and acquiring thorough familiarity and practical experience with American practices in the field.

The fact that the Chilean educational system follows more the European pattern does not impose difficulties in any way. If a young man has finished the equivalent of our high school training in Chile, he enters the evening division of an American college and takes about six years to complete the requirements for his bachelor's degree. If, however, as is customary, he spends two years in study in Chile after having the equivalent of American high school work, he receives advanced standing in the evening division and thus reduces to two or three years the time required to qualify for his bachelor's degree. Or, if he has completed in Chile the requirements for an engineering degree, he enters the graduate division of an American college as candidate for his master's degree. Candidates are selected by competition and are required to have a basic knowledge of English.

Several American industries have cooperated in this training program. Scholarships have also been made available at some engineering colleges. Thus, the passage to and from the United States is provided by the Pedro Aguirre Cerda Fundacion; scholarships provide for tuition; and allowances from employment contribute towards living expenses. Where such allowances are not sufficient to cover expenses fully, as may be the case in certain localities or where scholarship grants meet only part of the tuition, the Corporacion de Fomento provides the extra funds.

Plans are now under way for the training of 16 Chilean engineers. Cooperating in the selection and placing of these engineers is the Inter-American Training Administration in Washington, under whose direction student engineers spend one and one-half months in Washington on an orientation program prior to entering the industries and their college courses. On completion of their entire industrial and college training program, they return to Washington to undergo examination to determine the extent and thoroughness of their training. Immediately thereafter they go back to Chile to apply American principles and practices to Chile's industrial developments. Also cooperating in this program is the Institute of International Education, through whose offices are cleared all matters pertaining to scholarships, curricula, etc.

Our Versatile Members

Since engineers are not generally credited with as much interest in the arts as are some of the other professions, it is particularly gratifying that the hobby of one engineer—S. A. Bauer, Assoc. M. Am. Soc. C.E., of Cleveland, Ohio—has resulted in recognition in the artistic world. Mr. Bauer was recently awarded two prizes for sculpture by the Cleveland Museum of Art at the Annual Exhibition by Cleveland Artists and Craftsmen.

"There Was an Old Man Called Joseph"
Prize-Winning Work in Cleveland Art Exhibit

Mr. Bauer won first prize for his work entitled, "There Was an Old Man Called Joseph," reproduced in the accompanying illustration, and second prize for "Seated Woman." Both executions have been widely praised.

Further evidence of this engineer-sculptor's talent is the fact that the Cleveland Museum of Art purchased his last year's exhibit as a permanent acquisition to its collection.

Speakers' Branch Created by Army

A new Army Speakers' Branch has been opened in Washington, D.C., by the War Department. The program is in answer to numerous requests by professional organizations and industrial groups for speakers to describe Army activities at their meetings.

Combat veterans from all theaters of operations as well as technical specialists will travel from Washington on request to fill speaking engagements. A variety of subjects will be covered, and speakers will endeavor to present the War Department's general estimates of the military situation and the size of the job ahead.

Colonel Warren J. Clear, General Staff Corps, is chief of the Speakers' Branch. Colonel Clear is a well-known authority on Japan, having served as Military Attaché to the American Embassy in Tokyo for nine years prior to the war. Requests for speakers can be made to Capt. Alvin Graner, Speakers' Branch, Bureau of Public Relations, War Department, Washington, D.C. This office is located in the Pentagon Building.

Surplus Property Disposal by Army Air Forces

Quantities of surplus materials and equipment are being sold by the Army Air Forces. Raw materials, steel, copper, and aluminum products, and textiles are available in addition to precision tools and various types of equipment.

Interested buyers may place their names on the list of active bidders of the Property Disposal Section. For further information, address inquiries to the Chief, Property Disposal Section, Southeastern Procurement District, Army Air Forces, 86 Edgewood Ave., Atlanta 3, Ga.

N. G. Neare's Column

Conducted by

R. ROBINSON ROWE, M. AM. SOC. C.E.

I'VE been worrying, Isidore, lest those corrals at Duster Flat be too small for all the jerries Ike is sending."

"You needn't worry, Noah," replied Guest Professor Knobbe. "The Oaf Fence Corporation is making corrals on an assembly line and all we engineers have to do is to set them up in squares so that each side will be enfiladed from a guard tower. Did anyone guess the layout at Duster Flat?"

"I guessed lots of them," said Joe Kerr. "There's no end to the number of squares whose sides line up with the derricks. For instance, here (Fig. 1*a*) are 6 squares cornering at the westerly derrick *A*. The two bold ones are separate and can be combined with the dashed square *CD* or the little square *D*."

"Joe's right," agreed Ken Bridgewater, "except that there's an end to the number of squares —$n^2 (n-1)^2/_4$, where n is the number of towers. Of the 36 for $n = 4, 6$ are 2-pointers like *CD*, 24 are 3-pointers like Joe's 6 at *A*, and the other 6 are 4-pointers."

"I'll bet we're limited to 4-pointers," said Cal Klater. "Enfilade implies a target beyond the one you miss, excluding vertical fire. I drew the 6 4-pointers (Fig. 1*b*) and found 3 detached from each other and from the towers. I dimensioned them and that's my answer."

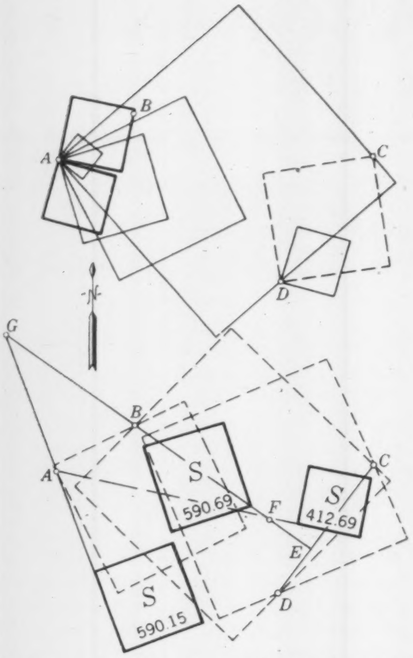


FIG. 1. DUSTER FLAT PRISON CORRALS

"And just as built, Cal, but which is the hospital?"

"The one marked *S* for sick-bay. Th others are marked *S* for square-heads an *S* for slant-eyes. Layout is easy. Draw $BE \perp CD$ and make $BF = BG = CD$. The AF and AG will be enfilades for 4-pointer and CF, CG, DF, and DG for 3-pointers."

"Which is just how the *SI* did it wit transit and tape, but the purists wil want the answers: $S = 34{,}650/\sqrt{3{,}44}$ and

$$S,S = \frac{300(17 - 21\sqrt{3})}{\sqrt{766 - 357\sqrt{3}} \pm 6\,(21 - 17\sqrt{3})}$$

"Noah, I think that makes everythin clear."

"Perfectly, Isidore. Thanks for the vacation, which I'm going to stretch with the help of Guest Professor Al G. Bray. Al, tell them about the chap who bet he could outrun his shadow."

"All right, Noah. He won his bet by setting a lamp in the SW corner of a rectangular armory which was 200 ft wide. Then he ran from this corner at 25 ft per sec while his shadow ran north from the SE corner at 20 ft per sec along the east wall. Where did he catch his shadow?"

[*Cal Klaters were Richard Jenny, James R. Bole and O'Kay (Otto H. S. Koch). Departing and arriving Guest Professors were, respectively, Joseph S. Lambie and Allen H. Brownfield.*]

State Highway Incomes Estimated

IN ANSWER to a request from Senator Hayden of Arizona, the Public Roads Administration has prepared an estimate of the incomes of the highway departments of the various states. The information, as tabulated, contained estimated receipts of the departments and additional road-user revenue, the latter amount subdivided into funds for non-highway purposes. For simplification, Table I has been prepared, which gives the total of all funds for the years 1945, 1946, and 1947.

This total includes the legal share of the state highway-user taxes and small amounts of predictable income from sources other than highway-user taxes. Also added into the totals is the legal allocation of state highway-user revenues to subdivisions of the states. The third amount included in the totals given in the table is the highway-user tax revenues which will not be available for highway purposes under present laws.

As examples of this last portion of the total estimated income, several instances can be cited. In Florida all the motor-vehicle registration fees (except a small amount for highway patrol) are dedicated by law to education. In Nebraska, 20% of the gasoline tax is dedicated to relief and public assistance. In Pennsylvania, 25% of the gasoline tax goes into the general fund. Thus, in several instances, the totals given in Table I may be misleading because a large percentage of them is not available for highway use.

This report was read into the Congressional Record of the Senate by Senator Hayden. Complete tabulation of these funds, indicating disposition of total income, appears on page 8198 of the Congressional Record for September 21, 1944

TABLE I. ESTIMATE OF STATE HIGHWAY INCOMES FOR 1945, 1946, AND 1947

STATE	1945 TOTALS	1946 TOTALS	1947 TOTALS
Alabama	$ 19,168	$ 21,284	$ 25,262
Arizona	5,634	6,051	6,750
Arkansas	14,032	15,236	16,993
California	77,841	83,604	92,707
Colorado	10,826	11,515	12,660
Connecticut	16,470	17,695	19,639
Delaware	2,801	3,177	3,850
Florida	30,126	33,793	39,597
Georgia	23,164	25,113	28,272
Idaho	5,285	5,911	6,846
Illinois	57,036	62,411	70,996
Indiana	32,789	35,571	40,116
Iowa	22,739	25,112	28,899
Kansas	14,358	15,187	16,528
Kentucky	17,369	20,556	23,710
Louisiana	21,328	23,228	26,206
Maine	8,827	9,714	11,130
Maryland	18,481	19,326	21,010
Massachusetts	22,552	25,086	29,112
Michigan	49,463	53,977	61,091
Minnesota	27,609	30,772	35,733
Mississippi	13,009	14,708	17,331
Missouri	21,625	23,578	26,603
Montana	5,267	6,097	7,339
Nebraska	10,950	12,063	13,850
Nevada	2,217	2,271	2,441
New Hampshire	$ 4,932	$ 5,695	$ 6,874
New Jersey	38,343	42,357	48,736
New Mexico	5,541	6,162	7,212
New York	93,717	107,077	127,934
North Carolina	34,933	37,891	42,620
North Dakota	4,644	4,993	5,554
Ohio	79,853	83,545	89,586
Oklahoma	21,332	23,764	27,549
Oregon	16,176	17,205	18,848
Pennsylvania	83,370	91,668	104,982
Rhode Island	5,927	6,555	7,496
South Carolina	14,110	15,968	18,976
South Dakota	5,494	6,149	6,972
Tennessee	25,139	27,721	31,879
Texas	60,328	67,270	78,070
Utah	5,261	5,391	5,608
Vermont	4,273	4,773	5,622
Virginia	25,613	27,959	31,635
Washington	21,303	22,540	24,546
West Virginia	17,584	19,520	22,482
Wisconsin	30,052	33,579	39,036
Wyoming	3,358	3,664	4,113
Dist. of Col.	5,560	6,365	7,647
Totals	$1,157,809	$1,270,847	$1,448,648